Telephone Engineer

Volume 35 AUGUST, 1931 No. 8

What Is Your Collection Practice? A new situation confronts telephone companies in many parts of the country and yet it is a situation that has been present to some extent ever since the telephone was first employed in commercial use. It is the matter of collections. Different practices have been in evidence at different periods. In the earlier days it was not altogether difficult to secure payment of one year's telephone rental in advance when the telephone was installed and quite often a bonus equal to the entire cost of installation was secured in addition to one year's rent.

The bonus system, like many other good things, was soon a thing of the past and instead of one year's rent in advance, three months was considered sufficient. This was well and good until the use of long distance became general, which made monthly collections necessary. Even then toll credits became a problem, for though the rent was billed a month in advance, the toll account could not be billed until the end of the month. According to general practice, the toll account is always from 30 to 50 days in arrears.

Practically all the larger companies and many of the smaller ones have a definite cut-off day beyond which the account is not carried. Until recently this system worked perfectly when tactfully employed and for years the telephone companies congratulated themselves on being able to collect better than ninety-nine and one-half per cent of their charges. Comparatively few subscribers permitted their telephones to be discontinued for non-payment and those who did made a bee-line for the telephone office to pay the bill and have the service restored.

According to reports being received at the office of TELEPHONE ENGINEER, the period of depression in many sections is being felt by the telephone companies more and more each month. This is not only reflected in long distance earnings but also in the increasingly large number of subscribers whose telephone service is discontinued through failure to pay their bills. In a great many of these cases it is either necessary to take the telephone out or extend credit. This places the telephone manager in a position where he either has to see his uncollected balances mount higher and higher, or his list of subscriber stations reduced from month to month. Either result is undesirable. If the former course is pursued the property earnings may be preserved on paper for awhile, but the day of reckoning will come sooner or later. Only a quick return of prosperity will enable the company that follows such a course to coast along until the profits will permit the balances to be charged off without depleting the net earnings.

On the other hand, any material reduction in the number of subscriber stations will not only reduce the book earnings but will also affect the capital account and bring about a showing equally as bad. What is the telephone manager to do? Our notion is that every questionable account should be charged off after thirty days past due, and when the subscriber falls behind, discontinue the service. Then if red ink creeps into the page, nobody has been deceived at any rate. In the meantime the practice of obtaining credit ratings on subscribers to telephone service is growing popular, and where the rating is not satisfactory, a deposit is required before credit for long distance service is extended.

C. A. Shock The announcement that C. A. Shock was retiring from the position of general manager of the Northern Texas Telephone company at Sherman came to us as a distinct surprise, and yet it was not a surprise when we permitted our memory to carry us back over the years and note some of the things that this staunch pioneer of the Independent telephone industry has accomplished for his own organization and helped to accomplish for the industry as a whole.

When we use the word pioneer, we do so advisedly, for C. A. Shock is yet a young man, comparatively speaking, and would resent the use of any appellation that would seem to indicate otherwise. It was about three years ago, as we remember it, that he participated in a game of baseball in the Sherman city league on a certain evening, and after his team had seemingly lost, he

came to bat in the last inning and with a safe hit tied the score and a little while later stole home for the winning run. The next morning he was taken to the hospital and had his appendix removed, and two days later the city commission of Sherman voted a substantial increase in rates, in response to an application that he had pending at the time he was taken sick. No representative of the telephone company was present at the time the vote was taken. In telling us of the incident, C. A. laughingly remarked that he suspected that there were a good many telephone managers that would be willing to have their appendixes removed if it would bring them an increase in rates.

"Twenty-seven and one-half years on one job," so the announcement reads, and much telephone history has been made in that time. We know that he was a very young man when he left Ohio where he first had telephone experience, to accept the management of the Grayson County Telephone company at Sherman and Denison, which counting back twenty-seven and one-half years, must have been in 1904. It was the following year when we assisted in establishing the Transmitter at Ft. Worth and our acquaintanceship dates from that time. During all the years that have followed, we have known no truer friend, or more loyal supporter of the cause for which we have both labored, each in his chosen field. Mr. Shock was one of the original founders of the Texas Independent Telephone association.

The brief announcement does not state what his future plans are except to say that after a short rest he will be back in the business that lies nearest his heart. This is glad news to his hundreds of friends in both the Bell and Independent fields, where his genial spirit, as well as his thorough and extensive knowledge of every phase of the telephone business, including construction, maintenance, operations, organization and finance, has won for him universal admiration.

Along with his other attainments, C. A. Shock has reared two sons whom he has trained in telephone work, and both have already made enviable progress in the career which they have chosen. Chad E., the oldest son, was born in Ohio and came to Texas with his parents when he was one year of age. He is local manager of the Northern Texas Telephone company exchanges at Garland and Rowlett, while Carl, the second son and a native Texan, is local commercial manager at Sherman.

After all we are not concerned about the future of C. A. Shock, since we learn that he is to remain in the telephone business. What we do wonder, however, is just how Sherman and surrounding territory would get along without him if his work should call him elsewhere. During his long residence in Sherman he has been prominently identified with every movement that has been fostered for the up-building of the city and surrounding community. He is a leader in church and civic affairs and has filled many important positions in connection with the schools, chamber of commerce, Y. M. C. A., and other institutions of public interest. It is also our recollection that for a number of years he has been officially connected with the Red River Valley Fair and that he is now serving the fair as secretary and manager.

While he would be missed in all these circles there is no doubt but that his retirement as general manager of the Northern Texas Telephone company has created a vacancy in the hearts of his employees that can never be filled. Many of them have been with him as much as twenty or twenty-five years and it has always been a delight to witness the spirit of good-fellowship that has existed between him and them when they have attended district and state telephone conventions together. Possessed of a deeply sympathetic nature, C. A. Shock's innermost being has responded to the heart throbs of those who served under him; their joys were his joys; their sorrows were his, and if any one of the one hundred and twenty-five men and women in his employ were sick or in distress, no road was too rough or too long for him to reach them with his aid and sympathy and we know that it is no wild guess when we say that today there is untold sadness in the hearts of the employees of the Northern Texas Telephone company, who, along with TELEPHONE ENGINEER, await the announcement of his future plans.

Our Engineering and Management Course

Reasons for Equipping Switchboard with Multiple Jacks as Soon as It Exceeds Five or Six Hundred Stations Are Outlined Here in the Seventh Installment of a Course in Telephone Instruction by B. C. Burden, Transmission Engineer, Lincoln Telephone and Telegraph Company

Multiple Switchboards.

When the number of subscribers lines served by a switchboard exceeds five or six hundred, it becomes necessary to equip each subscriber's line circuit with additional jacks.

These additional jacks are known as "multiple jacks" and are placed in the switchboard so that any operator can reach any subscribers line by plugging into the "multiple."

Multiple jacks are necessary for several reasons. In the first place one operator can take care of calls from only a limited number of subscribers lines, hence where the total lines exceed five or six hundred, it is necessary to utilize more than two operators. Inasmuch as

only a part of the total answering jacks appear in front of any operator and the cord circuit reach of the operator is confined to the panels directly in front, and to each side, some means must be provided so that any line can be reached by any operator.

Requirement number two is taken care of by designing the cord and sleeve circuit so that a difference of potential will exist between the sleeve of any jack and the tip of the answering plug, whenever a plug is inserted in one of the jacks. An indication of whether or not a line is in use is obtained by touching the tip of the answering plug to the sleeve of the jack before inserting the plug. If the line is busy the operator will hear a sharp click in her headset.

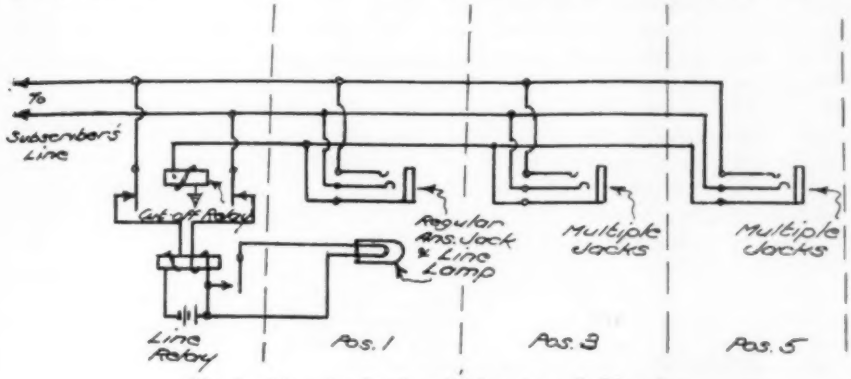

Fig. 1—Line circuit of multiple type switchboard

The multiple jacks occupy a very small space and it is possible to mount as many as 10,000 multiple jacks within the cord circuit reach of any operator.

It should be noted that in a true multiple type board the subscribers line lamp and associated answering jack appear at only one position, but the multiple jack appears at a number of positions and is within reach of any operator. Figure 1 shows schematically the line circuit on a multiple switchboard.

Multiple jacks introduce two problems not encountered in the simple non-multiple type circuits described in the July issue.

These are:

1.—The necessity for controlling the line lamp relay circuit from more than one jack.

2.—The necessity for giving some sort of busy test at all jacks when one of the jacks is in use.

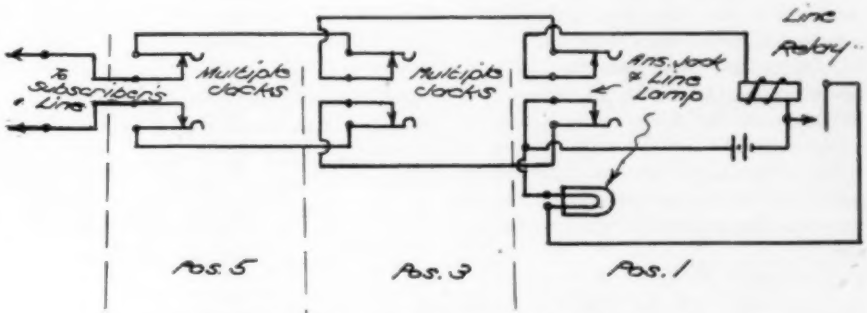

Fig. 2—Line circuit—series type, multiple switchboard

While the cut off relay multiple arrangement shown in figure 1 is the type most commonly used, an arrangement which has, and still is, being used to some extent is the "series multiple."

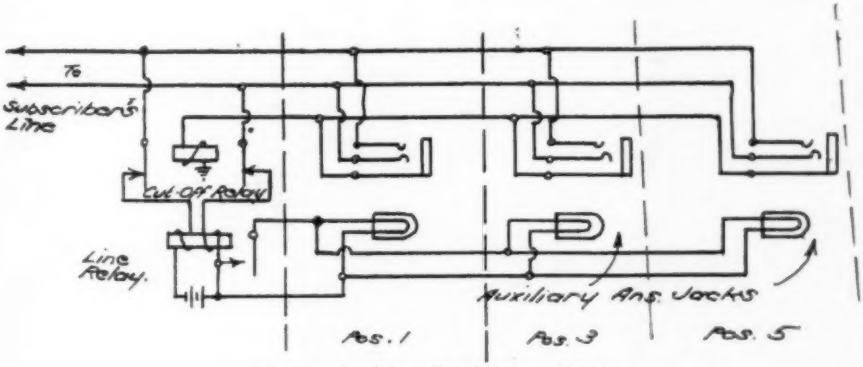

Fig. 3—Auxiliary line lamp multiple

The requirement for controlling the line lamp and cut off relay circuit is accomplished by merely bridging all of the sleeves of multiple and line jacks together. The insertion of the plug in any jack operates the cut off relay in the same manner as described in the previous article of this series.

The arrangement differs from the "cut off relay" type in that spring contacts on the multiple and answering jacks are utilized to disconnect the line relay from the subscribers line when a plug is inserted.

Figure 2 shows a simple schematic of this type of multiplying arrangement.

This arrangement has two objections, viz.: It introduces spring contacts into the talking circuit, and the multiple jacks occupy considerably more space than do the simpler three spring jacks shown in figure 1.

Auxiliary Line Lamp Multiple.

A method of multiplying which has become quite popular in recent years on the smaller size common battery boards, is the auxiliary line lamp multiple shown in figure 3. This arrangement is similar to that shown in figure 1 with the exception that a line lamp appears at each multiple jack.

This multiple appearance of line lamps permits a given number of operators to handle more calls per hour, and results in faster answering service to the subscriber.

By means of lamp cap designations a teamwork scheme can be forked out so that each operator is assigned certain groups of line lamps which she takes care of first, and when calls are not requiring attention on the lines assigned to her position, she then helps out on calls which come in on lines assigned to other operators.

This scheme is also referred to as the ancilliary line lamp multiple.

Operators Telephone Circuits.

Figure 4 shows the schematic of a typical common battery operators telephone circuit in use in modern switchboards.

It will be noted that this circuit differs from either the local or common battery subscribers set circuit. Its operation is as follows: Current from the central office battery flows through the series circuit consisting of the primary of the induction coil transmitter and retard coil. When the transmitter resistance is varied by the impressed voice wave, the retardation coil, because of its inductance prevents rapid fluctuations of the direct current flowing through it. The decrease in current which accompanies transmitter resistance changes is supplied by the charging and discharging of the condenser. The condenser is constantly being charged to a fixed potential by the current flowing through the retardation coil. The retardation coil thus

keeps voice frequency currents out of the battery which prevents any possibility of crosstalk between different operators circuits fed from the same battery.

The fluctuating current passing through the primary of the induction coil induces a voltage across the secondary which passes on to the listening key common wiring.

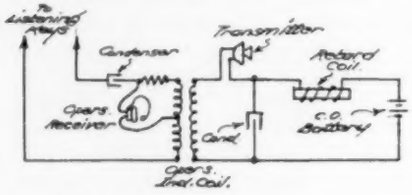

Fig. 4—Operators' telephone circuit

The operators receiver, it will be noted, is connected across only a part of the secondary winding of the induction coil and the resistance R.

The value of the resistance R is so selected as to form a partially balanced bridge circuit, so that but little side tone is heard in the operators receiver when the operators transmitter is spoken into.

On incoming voice frequency currents the receiver functions in a fairly efficient manner inasmuch as the bridge is unbalanced to incoming currents. A schematic of the electrical conditions set up in this anti-side tone circuit is shown in figure 5.

The advantage of the anti-side tone arrangement is the reduction in room noise heard in the operators receiver, as well as improved transmitting conditions which result from the operator speaking with more volume than she would if she heard considerable side tone from her own transmitter.

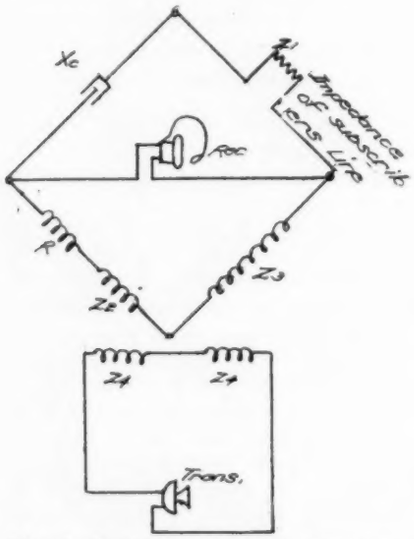

Fig. 5—Equivalent electrical circuit set-up in operators' telephone circuit

In addition to the regular windings operators induction coils on the larger boards are usually equipped with additional windings for monitoring, order wire, or chief operator purposes.

The monitoring winding is usually of such impedance that it draws but little current, hence does not materially effect the transmission when a set is bridged across this winding for monitoring purposes.

The order wire or chief operators windings are lower impedance windings and are used for direct communication between the operators, and wire chief or chief operator.

Order wire circuits are also in wide use in larger exchanges where trunk circuits are ordered up between offices.

Relays.

Before discussing the more complicated types of swichboards let us consider the various types of relays commonly used in modern switchboards

Relays should be thought of as electrically operated switches. For purposes of study they may be classified as follows:

Direct Current Relays:

1.—Non polarized type.
2.—Polarized type.
3.—Slow acting type.
4.—Differential type.
5.—Locking type.
6.—Double winding type.

A. C. Relays:

Several common types of simple direct current relays are shown in figure 6.

On this type relay the time between the closing of the operators circuit and the relay contacts is fairly short and depends on the length of armature travel, and the relay construction.

Polarized Relays.

Figure 7 shows the polarized type of direct current relay. It will be noted that the armature of this type of relay has a north and south pole set up on it by induction from the permanent magnet. By considering the flow of direct current through the coils of this relay it can be seen that the armature will operate so as to close the contacts only when current is passed through it in a certain direction.

A polarized relay, therefore, has the property of differentiating between currents flowing in opposite directions in a circuit.

Polarized relays are but little used in telephone exchanges, and find their greatest use in telegraph work.

Slow Acting Relays.

Slow acting or sluggish type relays differ from the simple direct current type relays mainly in their slow response to actuating currents which are sent through them.

In many of the more complicated switchboard cord circuits relays are required which will remain in the operated position for a short time after the energizing current is cut off. Step by step circuits also require relays which will hold up even though the current flowing through these relays be momentarily withdrawn.

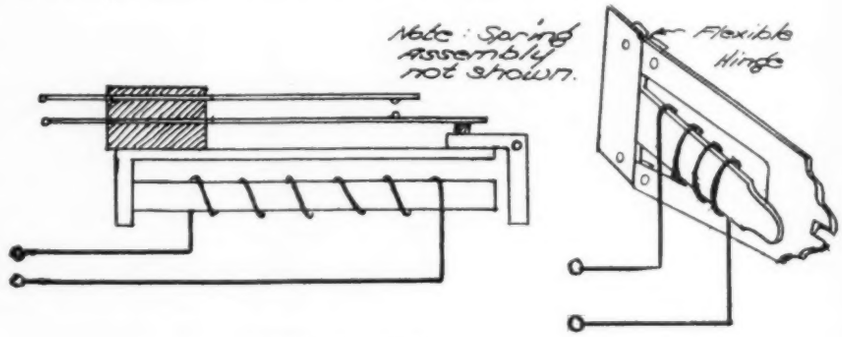

Fig. 6—Simple direct current relays

Slow acting relays are very similar in construction to the simple type relays except that they have some form of copper slug or sleeve placed over a part or all of the relay core.

The purpose of this sleeve or slug is to act as a single turn of very low resistance. When the current flowing in the relay winding is cut off the magnetic flux threading the copper sleeve begins to collapse thus setting up a low voltage in the single turn which it forms. Because of its very low resistance a considerable current circulates in it which is in such direction around the relay core that it reinforces the existing magnetic flux thus causing the armature to be retained for a short period after the actuating current has been removed.

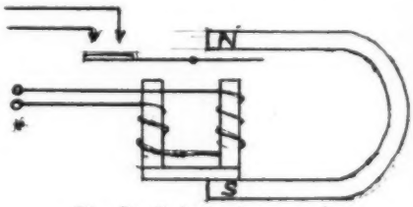

Fig. 7—Polarized type relay

The length of time during which the armature will hold up with the direct current source disconnected will vary from a fraction of a second to several seconds.

This "hold up effect" is determined primarily by the size of the copper slug or sleeve, being greater the larger the sleeve or slug.

Figure 8 shows the constructional fea-

tures of one type of slow acting relay. One feature of slow acting relays which is worth noting is the fact that they pull up much faster than they release. This is due to the lower magnetic flux change which takes place during the operating period because of the higher reluctance of the magnetic circuit as a result of the armature being in the open position.

Because of the influence which the

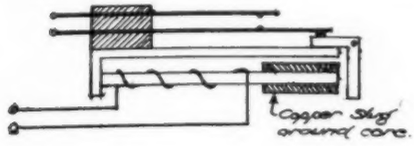

Fig. 8—Sluggish type relay

copper slug exerts on the response of the armature, it is evident that it would tend to slow up its closing to a smaller degree, than it tends to retard its opening.

Differential Relays.

Differential type relays are equipped with two windings which are arranged so that current flowing through one of the

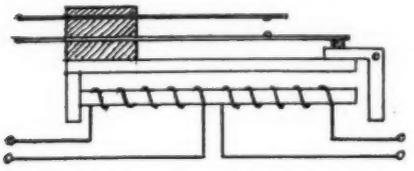

Fig. 9—Differential type relay

windings will cause it to operate, while if currents of the same value flow through both windings it will not operate.

This is accomplished by connecting the two windings so that the magnetic field of one winding will neutralize the magnetic field of the other winding.

Figure 9 shows this type of relay.

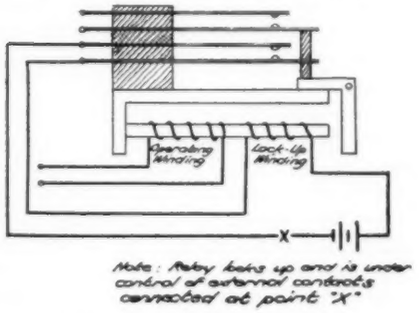

Fig. 10—Locking type relay

Differential type relays are used in the more complicated switchboards.

Locking Type and Double Wound Relays.

Locking type relays are relays with contacts connected to the operating windings in such a way that once the relay is operated the armature will remain in the closed position even though the initial circuit condition causing it to operate be changed.

Figure 10 illustrates this type of relay.

A typical example of the use of the locking type relay is the relay shown in the Universal Cord circuit, page 30 of the July issue of TELEPHONE ENGINEER.

Locking relays are usually arranged so that they lock up under some circuit condition and are released by the opening of a key or another relay circuit.

Double winding type relays are similar to the differential type relays except that the two windings are poled so that the current flows through them in such direction that the resulting magnetic flux adds rather than opposes, as is the case in the differential type relay.

A typical example of a double wound relay is the relay used for supervisory purposes in the Universal Cord circuit referred to above.

A. C. Relays.

Relays for operation on alternating current must be differently constructed than those used for direct currents.

There are two general types in use. One type uses for an armature, a reed which has a natural frequency approximately the same as that of the operating source. When current of the proper frequency is passed through it the reed will vibrate quite vigorously and can be adjusted to close or open contacts.

This type relay is used quite extensively in connection with toll line signalling.

The other type A. C. relay employs an armature similar to that used on regular d. c. relays, but so pivoted and of such mass that its inertia prevents it from causing the contacts to chatter when it is operated on low frequency alternating currents.

WE HAVE MOVED

Editorial and advertising offices of TELEPHONE ENGINEER, for the last several years located at 192 N. Clark St., Chicago, have been moved to larger and more centrally located quarters, at 185 N. Wabash Ave., Chicago. The telephone remains the same, State 8971.

NEW BUILDING FOR YORK EXCHANGE

Representing an expenditure of $375,000, the York Telephone and Telegraph company's new exchange building, at York, Pa., stands as a monument to the progress of oral wire communication.

The new building was begun in May, 1930, and was constructed by Hess Brothers company, of York. Although the switchboard and terminal equipment has been in use for six months it was not until July 25 that the office quarters were occupied.

The York Telephone company was organized in 1895 with 300 telephones. Today it furnishes telephone service to 15,842 stations with exchanges in 12 cities in addition to York.

The new building is two stories high, with a deep basement and is so constructed that at some future date five stories can be added.

Design of the office portion of the building, both on the exterior and the interior has been carried out in the modern style of architecture, which under the sharp limitations of structure, utility, and cost demanded by modern utility companies, has been adopted by the leading telephone companies throughout the United States as best expressing modern telephony.

THOMAS J. GULLION DEAD AT AGE OF 52

Thomas J. Gullion, 52, sales engineer for the Leich Electric company of Genoa, Ill., died July 6 at his home in Genoa. Death was attributed to heart trouble from which he had been suffering for several months. Mr. Gullion's death brought to a close 31 consecutive years spent in the service of the telephone industry.

Born in Lebanon, Ind., Mr. Gullion (known to his intimates as Tommy) entered the employ of the old Indianapolis Telephone company of Indianapolis, when still in his youth, as lineman and trouble shooter. Later he joined the sales department of the Western Electric company, traveling through northern Illinois and southern Wisconsin.

Twenty years ago he became associated with the Leich Electric company of Genoa, Ill., a connection which he maintained until his death. During his association with this firm he traveled first in Indiana and later in Illinois. Later, he returned to Indianapolis, starting a distributing company for Leich Electric company products under his own name. Ill health caused him to discontinue this venture and recently he made Genoa his home, acting as factory representative and sales engineer for Leich.

During his many years calling on the operating telephone companies, Mr. Gullion made numerous friends in the industry and was well acquainted with many in the power field, having served the last two years as sales engineer pioneering the sale of the Leich System Dispatching map.

Mr. Gullion was a member of the Indianapolis North Park Lodge A. F. & A. M. and Independent Pioneer Telephone association.

He leaves to mourn his death, his wife, one son, Donald Gullion of Pittsburgh, Pa., and two daughters, Mrs. Harold Eves of Muncie, Ind., and Miss Jean Gullion of Genoa.

Telephone News From the Southwest

Notes of Telephone and Utility Interests in the Central Southwest Which Previously Were Reported for Transmitter and Electrical Journal, a Regional Magazine of that District Which Has Been Absorbed by TELEPHONE ENGINEER, Appear in the Following Columns

Tidings From Texas

New Head for Northern Texas

Announcement comes from Sherman that effective August 1, Sam H. Shutt of Waco assumed the position of general manager of all the Telephone Bond & Share company local exchange properties in Texas, including the Northern Texas Telephone company exchanges, with headquarters in Sherman.

Besides the Northern Texas property, the Kansas City organization is also owner of the exchange property operated by the Texas Telephone company and the Texas Home Telephone company, both of Waco, and after August 1 Sherman likewise becomes operating headquarters for these companies. Telephone Bond & Share company is also owner of the Texas Long Distance Telephone company which operates extensively over the state of Texas.

For the past twelve years Mr. Shutt has been general superintendent of the Texas Long Distance Telephone company and has been succeeded in that position by L. S. Gardner of Waco, who until recently has had charge of the Texas Home properties and who is at this time president of the Texas Independent Telephone association.

In making the announcement of the change at Sherman, C. A. Shock, who for the past twenty-seven and one-half years has had charge of the Northern Texas properties as general manager, stated that after a brief rest he would be back in the harness again, helping to solve the many problems that confront the telephone man daily.

Gainesville Seeks Lower Rates

The city of Gainesville has requested the Southwestern Bell Telephone company to reduce its rates to those specified in the franchise under which the telephone company is operating in that city. The franchise rates are $2 and $4 per month. The company has been charging $2.25 and $4.50 for a number of years, however, but the city fathers are of the opinion that prices of telephone service ought to be reduced. At a recent hearing representatives of the telephone company submitted data showing that they are making less than 2 per cent at present rates. The aldermanic board took the figures under advisement and granted the telephone company an extension of thirty days longer during which the present rates may be charged.

San Antonio on War Path

The city of San Antonio by a unanimous vote of the city council recently created a new office, that of special utilities attorney. This action is said to be the first step of the city in an attempt to secure a reduction of gas and electric rates in addition to the fight against the Southwestern Bell Telephone company for a reduction in telephone rates. The ordinance creating the new office stated that its purpose was to insure the safety, welfare, convenience, health and good government of the city.

Employees of the Rio Grande Valley Telephone company held their annual picnic on the gulf coast at Boca Chica, a resort near Brownsville. About 250 employees and their families attended this picnic which was held Friday afternoon, July 24.

The Texas Associated Telephone company completed the installation of their new common battery switchboard at Rio Grande City on February 21, 1931, and are now giving service over it. The switchboard is a Stromberg junior multiple board and installation was handled by George Fitzgerald, installer for the Stromberg company.

The Rio Grande Valley Telephone company has completed its new two-story building at Brownsville and cut-over on July 12 to its new 18-position Stromberg switchboard at this building. A formal opening for the public was held on the evening of July 31.

The Texas Associated Telephone company completed the installation of a junior multiple common battery Stromberg switchboard at its La Feria exchange on January 24, 1931.

Pete Winemiller and D. L. Rochon of the Stromberg sales organization were visitors in the valley during July. Mr. Winemiller went fishing in the gulf and claimed that he caught a six-foot tarpon but was unable to produce the tarpon for close inspection.

The Southwestern Bell Telephone company has just completed a new toll line from Port Isabel to Los Fresnos. The growth of Port Isabel as a resort point has made necessary additional toll facilities and this gives an outlet through Los Fresnos, connecting with the new Los Fresnos-Brownsville toll line that was built about six months ago.

J. C. Paxton, the young and popular general manager of Rio Grande Valley Telephone company, with his wife, is spending his vacation visiting with relatives in Virginia. "Jimmy," as he is known among the fraternity, started his telephone career in the Carolinas when a young boy. He then entered Austin College at Sherman where he secured part-time employment with the Northern Texas Telephone company. After graduation he remained with the company at Sherman several years, after which he went to the Chicago office of the United States Independent Telephone association as statistician. From there he went to the Bell company at St. Louis and then on to his present position which he has filled for several years with distinction.

Observations From Oklahoma

Improvements in Oklahoma

Western Power, Light & Telephone company, with headquarters in Salina, Kans., has just completed two major telephone improvements in the Oklahoma panhandle.

The Western Telephone corporation of Oklahoma, a subsidiary, completed the addition of a copper circuit to their toll service between Boise City, Okla., and Elkhart, Kans., and the erection of a new toll lead from Boise City,

Okla., to the New Mexico state line, where it connects with a new lead built by the Mountain States Telephone company from Clayton, N. M, to the state line.

New Lines for Cloudy

The Southeast Oklahoma Telephone company has begun construction of lines into the vicinity of Cloudy, Okla., to serve people living in that community, according to O. H. Brooks, manager. The company also expects to build a trunk line from Cloudy community to Atoka and Antlers, Okla., to connect with the system of the Southwestern Bell Telephone Company. Several weeks will be required to put the lines in service, accrding to Mr. Brooks.

Want Common Battery System.

City commissioners of Kingfisher, Okla., have instructed the city attorney to bring action against the Western Telephone corporation of Oklahoma to secure installation of a common battery system without an increase of rates. It is claimed that the old Midland Telephone company, which was taken over by the Western Telephone corporation, agreed in its franchise to install a modern system in Kingfisher.

Oklahoma Pioneers Organize.

An Oklahoma chapter of telephone pioneers of America has been organized at Oklahoma City with a membership of 125. Only persons who have been in the service of some telephone company in the state for 21 years are eligible for membership. L. M. Jones, secretary of the employees benefit committee, was elected president of the state group; O. N. Dailey, special contracting agent, vice-president; O. E. Hopkins, district traffic superintendent, the Southwestern Bell Telephone company, Oklahoma City, secretary, and Miss Mabel Knouse, treasurer.

Twine Holds Lines Together.

According to the HENNESSEY (Okla.) CLIPPER workmen, while inspecting the telephone line southeast of Hennessey recently, found that the line had been severed in several places and tied together with binding twine.

Consolidate Two Exchanges.

A new common battery telephone system being installed by the Southwestern Bell Telephone company to serve Haileyville and Hartshorne, Okla., is expected to be completed by the middle of September, according to Joe Higgins, McAlester, district manager of the company. A new switchboard and associated equipment are now being installed in the new telephone building being constructed in Hartshorne.

The Southwest Telephone company is completing improvements to its telephone system in Wetumka, Okla. A common battery system will replace the magneto type of equipment.

New System for Arnett.

A new telephone system is being constructed at Arnett, Okla., according to the announcement of Jim Keffer, district manager of the Southwestern Associated Telephone company. The company will erect its own building in Arnett, change the Main street lines to the alleys and replace the open wire system with new cables. A new modern switchboard will also be installed.

Mid-Summer District Meetings.

Three mid-summer district meetings of the Telephone division of the Oklahoma Utilities association will be held at Duke, August 25; Medicine Park, August 26, and Sulphur, August 28. Three additional meetings will be held during September. A fall series of meetings is being planned for the months of November and December.

Want Special Mono-Phone Rates.

Telephone companies of Oklahoma appeared at a hearing before the Oklahoma Corporation commission, July 21, seeking authority to charge 25 cents differential for mono-phone sets. Representatives of several companies appeared for the purpose of submitting evidence to show additional cost in connection with giving this class of service. The Corporation commission continued the hearing indefinitely until the present investigation of rates is concluded by the commission.

Progress of Investigation.

Several new appraisal and valuation experts, clerks and auditors have been employed by the Oklahoma Corporation commission in connection with the general investigation now being conducted by that body into the rates and practices of telephone companies in Oklahoma. Appropriations to cover such employment were made by the 1930-31 legislature. The investigation as relating to the Southwestern Bell and Oklahoma-Arkansas Telephone companies was authorized by the last legislature.

In addition to the corporation commission investigation, Governor William H. Murray has ordered Attorney General J. Berry King to bring suit against the Southwestern Bell Telephone company for $500,000. The telephone company, Governor Murray alleges, has failed since 1920 to file a statement with the Secretary of State of its invested capital in Oklahoma, thus incurring taxes and penalties of approximately $500,000.

Vail Medal to Mrs. Kelley.

Mrs. Margaret Mae Kelley of Coweta, Okla., has been awarded a Theodore N. Vail medal for outstanding telephone service. The award was made at a public reception given her recently at Coweta. H. H. Armstrong of Tulsa, division commercial superintendent, presented the award. Mrs. Kelley, an operator for the Coweta-Porter Telephone company, was awarded the medal for remaining at her operator's post during a fire at Coweta last year, until she had summoned aid from nearby towns.

Program of Southwestern Bell.

The Southwestern Bell Telephone company is constructing an underground toll cable from Joplin, Mo., to Tulsa, Okla., via Vinita, and Claremore, Okla., to cost approximately $1,500,000. The company is spending approximately $150,000 in connection with this project for the erection of a repeater station on the underground cable line near Vinita, Okla. Work on both projects is now underway. This is part of an extensive underground toll cable construction program being carried out by the Southwestern Bell Telephone company in the southwest, which will involve the expenditure of approximately $5,000,000 in Oklahoma alone.

S. H. COUCH CO., INC., ACQUIRES BLAKE SIGNAL

S. H. Couch Company, Inc., has announced the acquisition of the business of the Blake Signal and Manufacturing company. The manufacture of Blake insulated staples will be continued at North Quincy, Mass.

Over a period of 25 years the Blake Signal and Manufacturing company has served thousands of customers and the S. H Couch company will carry on with the name of Blake and will endeavor to serve these customers as they have been served in the past.

Samuel H. Couch is chairman of the board of directors, Archie T. Morrison is president; J. Eric Atkinson, vice-president; Donald F. Cameron, treasurer, and William Couch, director.

NATIONAL ASSOCIATION WILL MEET IN OCTOBER

The annual gathering of members of the United States Independent Telephone Association will be held at the Hotel Stevens in Chicago again this year, and the dates decided upon are October 20 to 23rd, inclusive. According to F. B. McKinnon, president of the nationa lassociation, definite convention plans will not be completed nor announced until after Labor Day.

The Complicated Business of Tree Pruning

In Eliminating Branches of Trees to Provide Proper Clearance for Wires, Each Tree Presents a Separate Problem to the Tree Surgeon. Health of Trees Must Be Safeguarded by Proper Cutting and Treating of Wound, and Beauty Preserved by Maintaining Symmetrical Shape of Tree

By MARTIN L. DAVEY, President
The Davey Tree Expert Company

Throughout this country there are unnumbered millions of trees which home-loving and civic minded people planted and nurtured in bygone years. Many of these trees are along the streets and highways of the nation. Some of them represent the veneration of individual guardianship while others stand as living symbols of loved ones who have gone. And then there are innumerable cases where the street and highway trees represent the attachment of intimate association and a high regard for them as things of beauty.

Therein lies the difficult and vexing problem for the various public utilities whose wires must traverse the streets and highways of the nation in order to carry the indispensable service of telephone, telegraph and electric power to the homes, institutions, and industries of this country.

No. 1—Fairly satisfactory clearance was obtained by trimming the tree in the manner shown here. However, the branches at the left were quite limber and there was a chance that they could be blown against the wires by a strong wind. Moreover, the tree has been deformed by the trimming and has lost its symmetry and beauty.

The country needs the trees and it also needs the service performed by the electric wires. The trees are needed not only for their shade and beauty but for their finer esthetic and spiritual value. The wire service is needed in order to maintain that higher standard of living which it makes possible and which characterizes America and sets her apart from the other nations of the world.

It has been thought by many that these two things were diametrically opposed to each other and irreconcilable, but the modern right thinking public utility official has a jealous regard for the favorable opinion of the public. He realizes the need for trees; he respects the rights of the people; he undertakes to please the owners of trees and those who love outdoor beauty.

Consequently, the utility officials have been striving for years to solve the problem of how best to provide clearance for the wires without harming the trees. I shall discuss here the results which have been obtained in line clearance work by competent tree surgeons.

Pruning is the oldest form of tree care and perhaps for that reason there is a common belief that "anyone can cut a dead limb off a tree." Nothing could be farther from the truth

Danger in Improper Pruning

The greatest danger to which a tree is subjected by improper pruning undoubtedly is infection. Whenever a limb is cut, this danger is imminent, exactly the same as there is danger of infection when a person cuts himself or is operated on, and the wound is not properly treated. In the case of a person, blood poisoning is apt to occur; in the case of a tree, the almost inevitable aftermath of carelessness is decay.

Minimization of the danger of decay following pruning wounds is only one relatively minor thing that science has brought to line clearing. It has also served to hasten improvements in every phase of the work and, as a direct result, it has served to create a better feeling between the utilities and the public.

No line clearing operation can be considered successful by the utility unless adequate clearance is provided for the lines. And this "adequate clearance" does not merely mean cutting a pathway for the wires through the tree tops which will remain open only temporarily. Enough clearance should be provided so that the wires will be untouched by leaves, or twigs or branches for at least a year.

This means that the rate of growth of the tree must be taken into consideration. If it is of a slow growing species, it obviously is unnecessary to remove as many of the branches as would be required if the treee grew rapidly. There are no hard and fast rules regarding the amount of pruning that should be done. In all cases, the tree surgeon must judge for himself how rapidly the tree is likely to grow and prune accordingly. The growth, obviously, depends upon such factors as type of soil, climatic conditions and the species of tree.

No. 2—Here tree surgeons eliminated the menace of the adjoining branches and at the same time they performed the operation in such an artistic manner that the tree is now well shaped and beautiful.

Protect Wires from Limbs

In addition to cutting an adequate pathway for the wires, the tree surgeon takes precautions to make sure that the wires will be protected from limbs which might blow against them from underneath or from the sides. He must also make sure there are no overhead limbs which will sag upon the wires when they become covered with ice and snow or become heavy with rain. Moreover, he must make sure that there are no dead limbs in the tree tops which may be

broken down during storms and either break or short-circuit the wires. He is always on the lookout for trees which are so decayed or structurally weak that they continually menace the lines. When such trees are beyond saving, he cuts them down; if they are worth saving, he strengthens them with guy cables to eliminate the danger of their falling on the wires.

It is not exaggerating to say that providing proper clearance is the simpler part of the tree surgeon's task. It is more difficult to prune the trees in such a way that the good-will of the tree owners and of the public will be retained. To do this, he must prevent the trees from being physically harmed and at the same time, prevent their appearance from being materially marred. Both of these things are equally important.

Must Know Life Habits of Tree

To safeguard the tree's health, the tree surgeon must be thoroughly familiar with its life habits and idiosyncrasies. Some trees can withstand heavy pruning; other species are likely to be seriously affected if a considerable portion of the top is removed. The amount of cutting necessary to obtain a year's clearance on a poplar, for instance, would be apt to cause serious injury to slow growing trees like the white oak. On some trees, pruning wounds will heal rapidly; on others, the healing process is very slow. Each tree must be considered as an individual presenting a new problem to be solved; to treat all trees alike inevitably leads to trouble.

In pruning, the tree surgeon makes sure to cut all branches flush with the parent limb, in such a manner that the tree is aided in healing the wounds rapidly. To prevent infection while this healing process is taking place, the tree surgeon covers all wounds with a high grade, protective wound dressing which is an indispensable aid in keeping out bacteria, fungi and insects.

Projecting Stubs Cause Rot

The tree surgeon takes particular pains to make sure that no projecting stubs are left on any of the limbs which have been cut. Nature does not provide a way for these stubs to become healed over; inevitably they become infected and start to rot back. The decay may eventually penetrate deep into the tree, causing the heartwood to be destroyed and the tree's structural strength to be impaired. When this occurs, the life of the tree is endangered. Moreover, the wires may be broken should a rotted branch crash down upon them.

The work of tree surgeons is greatly facilitated because of their ability to get to all parts of the tree with amazing dexterity by the use of ropes. They never use spurs inasmuch as each hole made in the trunk of the tree by the sharp points leaves an opening through which the tree can become infected. Incidentally, tree surgeons never use axes in their work except for cutting down trees. Ax wounds are almost invariably jagged and consequently will not heal rapidly. Saws are always used for the pruning work and the wounds are so cleanly made that the healing process is hastened.

Preserving the appearance of a tree is just as important to the tree surgeon as safeguarding its health. If a tree is deformed by the pruning or if unnecessary cutting has been done, the utility almost always is criticized and ill feeling is generated which often is difficult to overcome. Consequently, the tree surgeon removes no more branches than is essential and he tries in every manner possible to have the tree look as beautiful after the operation as it was before he touched it.

Preserving Beauty of Trees

Knowledge of a tree's life habits and characteristics is just as essential in preserving its beauty as in safeguarding its health. Some trees, for example, grow in such a manner that they can be headed back over a period of years and their natural beauty will not be destroyed. To do this on other species, however, would result in a queer, unsightly malformation. To head back a large elm, for instance, would destroy its beautiful, vase-like shape and make it a queer looking tree indeed.

Knowing a tree's characteristics, the tree surgeon is enabled to shape it up in such a manner, after the proper clearance has been obtained, that its appearance will be favorable. "Shaping-up" may mean the rounding of a side of the top; it may mean taking off a branch that overhangs the wires and gives the tree a curious "notched" appearance; it may mean the removal of some branches that throw the tree out of balance and prevent it from having a symmetrical shape. This work is one of the most difficult phases of line clearing and it is also one of the most important—when it is done properly, the good-will of the tree owner almost invariably is retained.

The point that each tree presents a separate problem cannot be overemphasized. Each is a living, breathing thing that has its own peculiarities, just as a human being has his. To prune all the trees along a highway with exactly the same methods would have almost as bad consequences as though a physician, making a round of calls, would prescribe the same remedies to all his patients. The remedy that might cure one patient would kill another—and the same thing is true of trees.

Building Good-Will for Utility

In order to build up good-will for the utility, the tree surgeon always gets written permission from the tree owner before pruning any of his trees. Also, if such clearance has to be done, he consults with the owner regarding the work, explaining what limbs have to be cut and why. The time taken to do this is well spent inasmuch as it greatly minimizes the chance of complaints and damage suits.

Tree surgeons are seldom denied permission to trim the trees for wire clearance. Practically all tree owners realize that the power and signal service cannot be disrupted and when they learn that the utility thinks enough of the trees to employ experts to make sure that the work is done right, they almost invariably allow the work to proceed.

No. 3—Working high above the ground, the tree surgeon often has to get in precarious positions. However, he is protected from falling by ropes which he has learned to use with amazing dexterity.

Micro-Rays Provide Two-Way Radio Circuit

Radio Telephony and Telegraphy Accomplished on 18 Centimeters Wave Lengths in Demonstration March 31, 1931, Between Dover, England, and Calais, France; From Distances Covered and Results Obtained Believe Equipment Employed Can Readily be Adapted to Commercial Use

On the cliffs at St. Margaret's Bay, Dover, England, on Tuesday, March 31st, the International Telephone and Telegraph laboratories, Hendon, England, in cooperation with the laboratories of Le Materiel Telephonique, Paris, France, gave a successful international demonstration of a new ultra short wave radio telephone and telegraph equipment and circuit between Dover, England, and Calais, France. This equipment was largely developed by French engineers in the Paris laboratories. The demonstration at Dover was conducted by engineers of the International Telephone and Telegraph laboratories and at Calais by engineers of Le Materiel Telephonique.

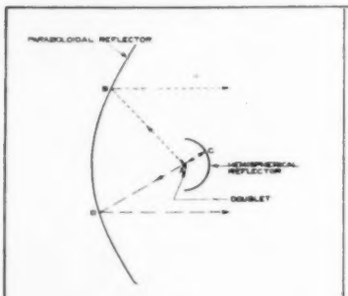

FIG. 1.

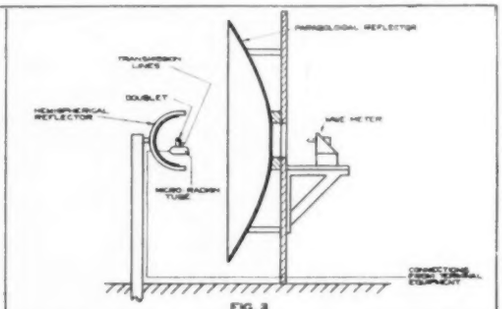

FIG. 3

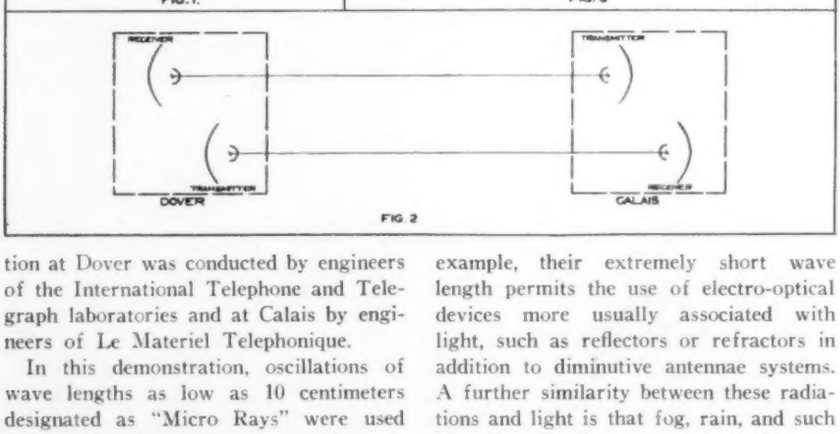

FIG 2

In this demonstration, oscillations of wave lengths as low as 10 centimeters designated as "Micro Rays" were used for the first time to provide a high quality two-way radio telephone circuit. From distances covered and results obtained, it was quite clear that the equipment employed can readily be adapted to commercial use. Though a certain number of experimenters have already succeeded in generating and utilizing oscillations of such wave lengths nothing beyond what may be described as laboratory investigations has up to now resulted. The enormous advance in technique shown by the present demonstration definitely indicates that the range of wave lengths as low as 10 centimeters are now available for commercial radio transmission.

Immune from Fading

In the demonstration a link had been established between a station on the cliffs of St. Margaret's Bay, near Dover, and a similar station across the Channel at Blanc Nez, near Calais. The two-way radio telephone circuit using a wave length of 18 centimeters was noteworthy for the quality of speech received. Not only was it well up to the standard of a high quality telephone circuit, but it showed no signs of being affected by fading, a disability from which waves in this frequency are apparently immune.

When compared with radiations of the more usual wave lengths, "Micro-Rays" present many striking features. For example, their extremely short wave length permits the use of electro-optical devices more usually associated with light, such as reflectors or refractors in addition to diminutive antennae systems. A further similarity between these radiations and light is that fog, rain, and such like climatic effects, as well as day and night, do not materially interfere with the propagation of the waves.

The two stations at Dover and Calais were in all essentials identical. Each comprised a transmitter and receiver with terminal equipment of normal design for connecting them together so as to give facilities for two-way communication.

Figure 3 shows the essential features of the transmitter, and Figure 5 is a reproduction of the photograph of the transmitter and receiver at Dover. The outgoing signals are applied to a "Micro-radion" tube in which the high frequency oscillations are generated. A short transmission line connects the "Micro-radion" tube to the radiating system or doublet which is about two centimeters long, in contrast to the enormous system usually employed. The amplitude of this high frequency current along the doublet at any instant is substantially the same. The doublet is situated at the focus of a paraboloidal reflector some three metres in diameter.

After concentration of the rays by the paraboloidal reflector into a fine pencil of rays somewhat similar to light rays sent out by a searchlight, they are projected into space. In the reflector the relation between the focal length and the diameter is so proportioned as to ensure maximum efficiency for the diameter used. In order further to increase the efficiency of the system by the prevention of radiation other than in the required direction, a hemi-spherical reflector is located at the opposite side of the doublet to the paraboloidal reflector and having the doublet at its center. This serves to collect all the radiation propagated in a forward direction and to reflect it back again towards the source.

Semi-Spherical Reflector

The radius of the hemi-spherical reflector is so chosen that when the reflected radiations reach the focus again they are in phase with those being radiated at that instant. The appropriate length of the radius depends upon the wave length, the relation being that it should be substantially a multiple of half wave lengths, namely, N multiplied by Lambda divided by two. The factor "N" is so chosen that the radius shall be large enough to ensure that the reflector has satisfactory electro-optical properties, but not so large as to intercept unduly the radiations reflected forward from the paraboloidal reflector.

The function of this hemi-spherical reflector is illustrated in Figure 1, the effect of diffraction being neglected in this description, although in practice it must be taken into account. It will be seen that the direct radiations such as AB pass straight to the paraboloidal reflector and so are directed towards the distant receiver, whereas waves such as AC are reflected by the hemi-spherical reflector back through A onto the paraboloidal mirror at D, and so out in the required direction.

It is estimated that the gain due to the paraboloidal reflectors on one channel is of the order of 46 decibels to which the hemi-spherical reflectors add another 6 decibels.

Measuring Frequency Output

A further interesting point is the ar-

(*Continued on page* 28)

Characteristics of Strowger Relays

Discussion of Features of Horizontal Relay Structure Which May Be Varied to Secure Different Performance Characteristics and Which Account for Long Life of this Type of Relay, by R. W. Graybill, Research and Development Department, Automatic Electric, Inc.

The preceding articles of this series have discussed the analysis of horizontal relay performance. In this article we shall consider some of the features of the horizontal relay structure which may be varied in order to secure different performance characteristics and also the features which give this type of structure its long life under various kinds of service conditions.

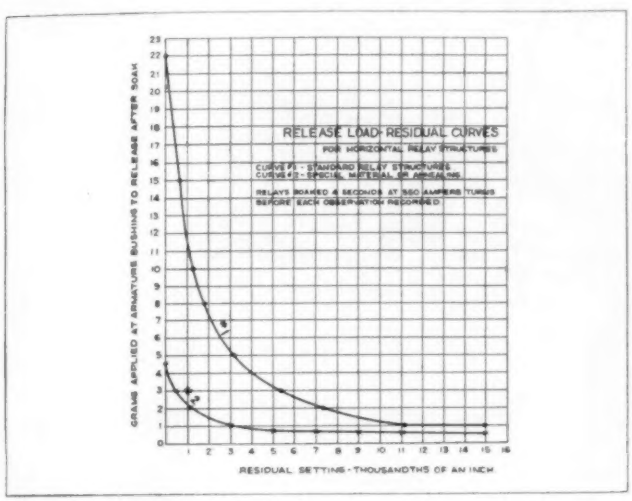
RELEASE LOAD-RESIDUAL CURVES
FOR HORIZONTAL RELAY STRUCTURES
GRAMS APPLIED AT ARMATURE BUSHING TO RELEASE AFTER SOAK
RESIDUAL SETTING - THOUSANDTHS OF AN INCH

Fig. 1

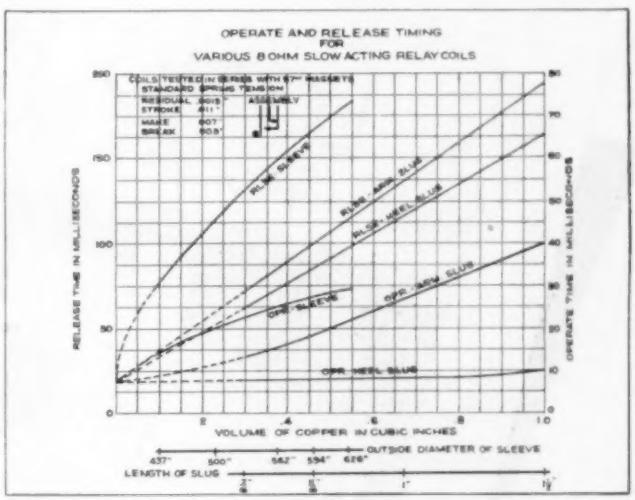
OPERATE AND RELEASE TIMING
FOR
VARIOUS 8 OHM SLOW ACTING RELAY COILS
RELEASE TIME IN MILLISECONDS
OPERATE TIME IN MILLISECONDS
VOLUME OF COPPER IN CUBIC INCHES
OUTSIDE DIAMETER OF SLEEVE
LENGTH OF SLUG

Fig. 5

The necessity for an armature load which is not too small is sometimes overlooked when it is desired to adjust a relay to operate on a very low current. All magnetic materials tend to retain a part of the magnetism built up at the time the coil is energized. This retained magnetism is commonly called residual magnetism. Residual magnetism tends to hold the armature operated, and the spring load and residual adjustment must be great enough to restore the armature in the presence of maximum residual magnetism. The spring load necessary to restore the armature of a horizontal type relay with various residual gaps is plotted graphically as curve No. 1 in Fig. 1. This data is obtained by first magnetizing the relay structure with sufficient flux to produce practically complete magnetization and then determining immediately after such magnetization what load in grams on the armature bushing is required to release the armature with various residual gaps.

Advances are constantly being made in the metallurgical field, in the production of better magnetic materials and the development of improved heat treating methods. Referring again to Fig. 1, which records the release characteristics of standard horizontal relays at curve No. 1, it will be observed that a curve No. 2 is also recorded. Curve No. 2 represents a much improved release performance because it indicates release of the armature with a much smaller spring load or residual gap. The characteristics represented by curve No. 2 may be produced in horizontal relays either by substituting an improved magnetic material or by the use of an improved method of annealing applied to standard materials.

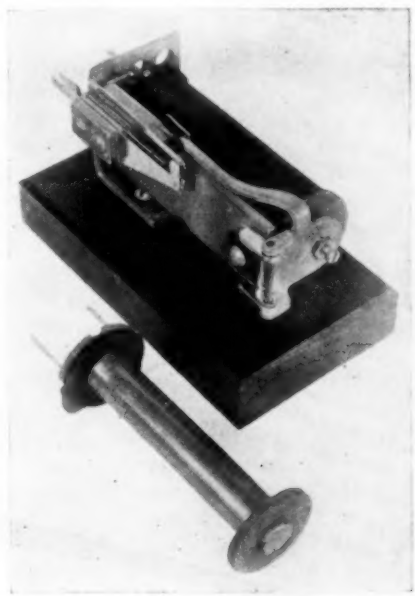

Fig. 2

Conditions sometimes require that relays release or operate within given time limits. Operate time for a relay is measured from the closing of the coil circuit until the relay springs break or make. Release time is measured from the opening of the coil circuit until the relay springs break or make. No satisfactory data is available from which operate and release times of relays with various coils and spring loads can be accurately calculated. Relays which must meet certain time limits are engineered by adjusting and testing a number of samples with timing devices. In order to secure comparatively long operate and release times coils are made up having large copper collars (slugs) or sleeves around the core as illustrated in Figs. 2, 3 and 4. Any change in the flux through these copper slugs results in a counter electro-motive force and associated current in the slug which builds up a magnetic field tending to oppose the change, i. e., to prolong the existing condition. This action is true during both operation and release for copper sleeves (Fig. 2) over the coil core, and for copper slugs on the armature end of the core (Fig. 3) but is only true during release for copper slugs on the heel end (Fig. 4) of the core. Heel and copper slugs do not delay operation because the flux builds up rapidly in a leakage path in front of the slug and causes operation of the armature. After operation the flux slowly establishes a path through the

*Editor's Note: This is the first half of Article 4 of a series by Mr. Graybill dealing with relay characteristics. The second half of Article 4 will appear in the next issue.

L O N G

"Our LONG DISTANCE telephone bill is one of the best investments we make"

THE TELEPHONE brings marked economy in the transaction of inter-city business. Saves valuable time for executives. Speeds production and deliveries. Straightens out misunderstandings. Simplifies operations.

A leading flour mill company uses Long Distance in all phases of its business. Executives at the home office direct branches and mills in various parts of the country chiefly by daily telephone calls. They maintain personal contact regularly with out-of-town customers by telephone. Speaking of the firm's Long Distance bill, an official says: "We think it is one of the best investments we make."

A textile company was in the market for goods of a certain kind. Prices quoted were not satisfactory. The purchasing agent telephoned three different cities. With the information gained, he saved his firm $6000 on one order.

A large Ohio specialty company, through its sales manager, closed a $45,000 deal during a three-minute telephone call to Kansas City. Cost of the call, $3.

Inter-city calls cost little, yield big. Typical station-to-station day rates: New York to Boston, $1. Pittsburgh to Indianapolis, $1.50. Seattle to Omaha, $5. Evening and night rates, still lower. Get things done by telephone . . . *Quick* . . . *Inexpensive* . . . *Resultful*.

DISTANCE

Presented as a business tool

IN THE light of current economic conditions, long distance telephone service assumes a new significance. Men who once employed it only in emergencies are discovering that it is an effective every-day business tool. They're using it to cut selling costs, keep contacts alive, open new territories... in scores of different ways.

That *all* business men may know the value of Long Distance and apply it profitably to their own affairs, advertisements like the one on the opposite page are appearing in many of the publications that business men read.

Based upon the actual experiences of representative concerns, these advertisements present long distance telephone service as a modern business investment. Simple, vigorous illustrations make them attractive. Crisp captions and copy make them readable. Accurate facts and figures make them convincing.

Advertising of this character benefits business generally by the broad service that it offers. And it strengthens the telephone industry particularly — both Bell and connecting company — by stimulating long distance traffic.

An Advertisement of the American Telephone and Telegraph Company

copper slug and consequently when the circuit is opened the heel and slug does build up a field which provides slow release action.

By making use of the various coil windings and copper slugs it is possible to design relays having operate times of from .003 to .150 seconds and release times of from .003 to .250 seconds. The average quick-acting horizontal relay operates in less than .015 seconds and releases in less than .010 seconds. When long release times are secured such as .150 to .250 seconds, the regular commercial product may be expected to vary from the stated values to 100 per cent greater values. Lower release times and

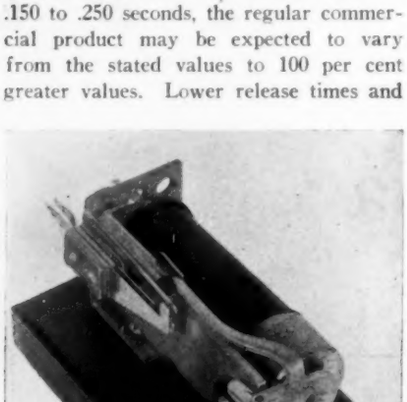

Fig. 3

all operate times may be held to closer limits.

Studies have been made at various times to select the correct size and location of copper slugs or sleeves to provide a desired operation. Operate and release times have been recorded for the various

Fig. 4

arrangements during such tests. Operate and release times for various copper slugs and sleeves are recorded in Fig. 5 for a three spring (make-before-break combination) relay which operates in series with switch magnets. The data in Fig. 5 is typical of that obtained from similar tests and discloses the effect on operate and release time of variation in the size and location of copper slugs and variation in the size of sleeves. It will be observed that the armature and slugs give a little longer release time values and a great deal longer operate time values than heel and slugs. For the volumes of copper usually used, sleeves give much longer operate or release values than either heel end or armature and slugs. It is therefore possible to use a smaller volume of copper in the form of a sleeve than that required for copper slugs to secure either slow operation, or slow operation and slow release in combination. Copper sleeves cannot be used to secure quick operation and slow release in combination, such as is provided by heel and slugs. Judging from the slope of the operate time curve for sleeves, it seems that this curve will intersect the armature end slug curve below the "one cubic inch of copper" line. Such intersection would indicate that the sleeves would require equal or greater volume of copper than armature end collars for all volumes of copper greater than that at the point of intersection.

MICRO RAYS PROVIDE TWO-WAY RADIO CIRCUIT

(*Continued from page* 24)

rangement made for measuring the high frequency output at the transmitter. For this purpose an aperture is provided in the center of the paraboloidal reflector through which part of the radiation passes. By making the diameter of the aperture slightly smaller than that of the hemi-spherical reflector no loss of radiated power results. The radiations passing through the aperture fall upon the special measuring instrument employed, as indicated diagrammatically in Figure 4. This takes the form of a wave meter calibrated for and normally set to the transmitted frequency. It comprises a small receiving antenna in which the induced E. M. F. is used to act upon a thermo couple junction. The readings of the associated galvanometer are an indication of the radiated power, while the distance between the antenna and metal screen, being adjustable, also enables wave length measurements to be made. In the demonstration the wave length use was 18 centimetres while the radiated power was about half a watt.

The receiver is a counterpart of the transmitter except that no high frequency measuring device is provided. That is to say, it comprises a doublet connected by a transmission line to the "Micro-radion" tube where detection takes place. Paraboloidal and spherical mirrors exactly similar to those of the transmitter are also provided for concentrating the received waves upon this doublet.

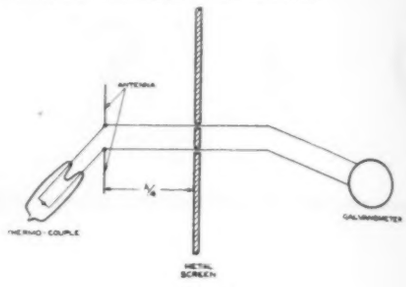

Fig. 4

To avoid coupling, the receiver is situated about 80 yards from the transmitter at each terminal and is arranged to be in its electro-optical shadow, adequate allowance being made for diffraction. The arrangement will be apparent from Figure 2. The same wave length is used both for sending and receiving.

The success of this demonstration has definitely shown that a wave length range as low as 10 centimeters is opened up. The importance of this from the point of view of ether congestion need hardly be stressed. Calculation will show that the range of frequencies available in the "Micro-metric" wave band (between 10 and 100 centimeters) is some nine times as great as in the whole of the ordinary radio field. Added to this is the fact that the radiations can easily and cheaply be concentrated into a small solid angle.

Practical Uses for Micro-Rays

Commercial applications in a world-wide communication network like the International System are obvious.

The frequency band available will permit the working of a very large number of permanent and continuous channels between the same places without mutual interference.

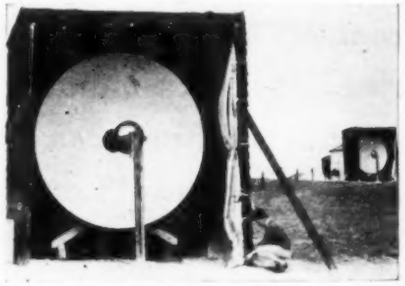

Fig. 5—The above photo shows the transmitter and receiver at Dover. By means of apparatus associated with the 10 ft. reflector seen in front of the hut, rays oscillating sixteen hundred million times a second are projected into space

A further very important use will be for television transmission. The present difficulty with regard to television is the very large frequency range required for satisfactory definition of the object transmitted. It should now be possible to allocate as wide a band as is necessary for

(*Continued on next page.*)

News From the Field

The new central office building of the Commonwealth Telephone company in Chilton, Wis., is expected to be completed and ready for occupancy within a month. The new plant will give Chilton a modern, fireproof building with the latest type of telephone equipment.

Keystone Telephone company of Philadelphia has been awarded a contract by the board of education of the school district of Philadelphia for installation of a complete automatic telephone system connecting all administrative and school buildings in the school system.

Farmers Telephone company of Amboy, Ill., has placed an order for four tons of copper wire with which to replace their toll lines in the country.

All records of the Dixon Home Telephone company, Dixon, Ill., were broken during July when 4,000 telephones were being operated. This was the largest number of subscribers in the history of the company.

Dividends paid by telephone and telegraph companies in June amounted to $8,988,319, according to the Standard Statistics company, of New York. Total cash dividend payments in June amounted to $412,327,778.

With the increase in assets in 1930 the American Telephone & Telegraph company passed the three-billion mark for the first time, making it the second largest corporation in the United States. Assets in 1930 rose about 32 per cent to $3,162,926,191.

Iowa and Missouri operating companies of the Associated Telephone Utilities system sold nearly 1,000 new telephone installations during a four weeks' sales campaign just concluded, officials have announced. Similar sales campaigns are planned for the eastern territory of the system.

A state charter has been granted the Champaign County Telephone company, of Champaign, Ill., to create telephone exchanges in Champaign county.

Improvements amounting approximately to $17,000 are being made to the telephone exchange at Whitewater, Kans.

The Kentucky State Telephone company, operating twenty-five exchanges in Kentucky, has passed into the hands of a receivership. John W. Byrne, for many years manager of the concern, was appointed receiver.

The contract has been let for completing construction of the new building of the Chesapeake and Potomac Telephone company of West Virginia, in Charleston. The contract is for an amount slightly less than $400,000. Designed primarily to house telephone operating equipment, the building will also contain office quarters for administrative and executive departments.

The Assumption Mutual Telephone company operating in Assumption, Ill., and vicinity has been ordered by the Illinois Commerce commission to change from the present magneto type of exchange to common battery service.

Ground is being broken in Roseville, Ill., for a new telephone building to be erected there by the Illinois Valley Telephone company. The structure will be one story, 18x28, surfaced with a tan faced brick, with a stone coping which will border the front of the building.

The division office of the Western Telephone corporation of Iowa previously located in Omaha has been moved to Denison. This company purchased the Denison exchange of the Crawford Country Telephone company about a year ago.

A new telephone building is being erected at St. Mary's, Ohio, to house the St. Mary's Telephone company.

Operating companies of the Associated Telephone Utilities system have reduced the average time for handling long distance toll calls from 2.2 minutes in 1929 to 1.4 minutes, according to recent figures made public.

The Southern Indiana Telephone company has recently completed another trunk circuit to Dillsboro, making a total of two trunk circuits for Dillsboro.

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television without causing any ether congestion.

For navigation purposes and especially for radio beacons the simplicity of the transmitters has obvious advantages.

Valuable applications seem possible in ship to ship communication, as the small size of the equipment would enable easy use to be made of its directional properties. In addition, the Micro-Ray system affords a satisfactory method for virtually secret inter-communication between war vessels.

Demonstration was also given of the high speed facsimile transmission system developed by the International Telephone and Telegraph laboratories.

While this successful demonstration proves the practicability of the Micro-Ray, further refinements are being carried on to prepare it for everyday commercial application.

It is interesting to recall that just forty years ago another pioneering departure, the first submarine telephone cable between England and France, was laid over practically the same ground as yesterday's epoch making achievement.

Distinguished officials of the British Government and Military and Naval Attaches from various countries, leading scientists and representatives of the press attended the demonstration at Dover, while a similar group of French Government officials and guests came from Paris to Calais to participate in the demonstration.

Special trains took the guests from Paris and London to Calais and Dover. After the demonstration there was a luncheon in England at the Lord Warden hotel where G. H. Nash, executive vice-president of the International Telephone and Telegraph laboratories, lectured on the Micro-Ray system. In France there was a similar lecture by E. M. Deloraine of Le Materiel Telephonique. In addition to Messrs. Nash and Deloraine, credit for the new system is largely due to Messrs. Clavier, Darbord, Fournier and Gibson.

CHICAGO APPROVES 23-YEAR TELEPHONE FRANCHISE

Disagreements and wrangling between the Chicago city council and the Illinois Bell Telephone company, which began when the old franchise of the telephone company expired in January, 1929, and has lasted for the two and a half years since then, were brought to a close July 31st when Mayor Cermak of Chicago signed the new telephone franchise ordinance, passed by the city council July 20th.

The ordinance fixes the term of the telephone franchise at twenty-three years from the expiration of the old franchise. This makes the term end in 1952. After that, six months' notice by either city or company is sufficient to terminate it.

Compensation to the city is fixed at three per cent of the gross revenues, with a minimum compensation of $2,000,000 a year. The city has already been given a check for $4,759,709, representing compensation for use of city streets between expiration of the old franchise, January 8, 1929, and March 31st of this year.

The new franchise is more lenient than the old in fixing the obligation of the company to pay for relocation of its lines in connection with subway building or other public improvements. The old measure obligated it to pay the full cost, while the new one provides that it shall pay no greater proportion than the Commonwealth Edison company or the Chicago Local Transportation company.

Ground Versus Metallic Lines

Address Delivered at the 1931 Convention of Kansas Telephone Association by Harry N. Faris, Telephone Consultant and Technical Engineer for United Telephone Company, Abilene, Kans.—Writer Emphasizes Fact That Common Battery Service Requires Full Metallic Lines.

Harry N. Faris, Technical Engineer, United Telephone Co., Abilene, Kansas

This discussion is not to be restricted to rural lines for the reason that among the Independent magneto exchanges in Kansas approximately 94 per cent of all city lines are ground return and only 6 per cent metallic. Rural lines, in the same exchanges, classify about 6 per cent full metallic, 4 per cent part metallic or "mixed," and about 90 per cent ground return. So the problem of the ground return city line in magneto exchanges is co-important with that of the ground return rural line and will be treated accordingly.

To clean up the subject of ground return lines completely we must also recognize that ground return lines are not confined to magneto exchanges, but that perhaps 2 per cent of the local lines in Kansas Independent common battery plants are also operating ground return. The latter is an entirely improper condition which should be cleaned up as speedily as possible.

Common Battery Rate Orders Specify Metallic Service

Most common battery rate orders specify metallic service and but few common battery plants in the state were deliberately planned to operate on ground return lines. In fact we know of but two common battery switchboards in Kansas in which the cord circuits were designed, or have been altered, for good transmission on ground return lines.

The very principle of common battery operation requires a storage battery common to the entire exchange. The positive side of this battery must be grounded so that all leakage in wet cables will be from wet paper to copper. Any reverse leakage from copper to wet paper would fill the paper with copper salts almost impossible to expel.

All common battery circuits therefore contemplate a ground at the neutral point, and when the nentral point of a circuit is grounded it becomes impracticable to ground either side of the circuit, in addition, without short circuiting one-half of the battery feed system. In the case of either repeating coil or double-wound relay feeds, an inductive short circuit results, reducing transmission almost to commercial limits even on local connections.

While it is possible to design a battery feed with single wound, non-coupling relays in both tip and ring sides, this practice is rarely resorted to as it reduces the supervisory limits quite materially.

In short, common battery, ground return lines should never be employed and, in exchanges not having cord circuits

TYPICAL COUNTY SEAT RURAL SYSTEM IN EAST CENTRAL KANSAS

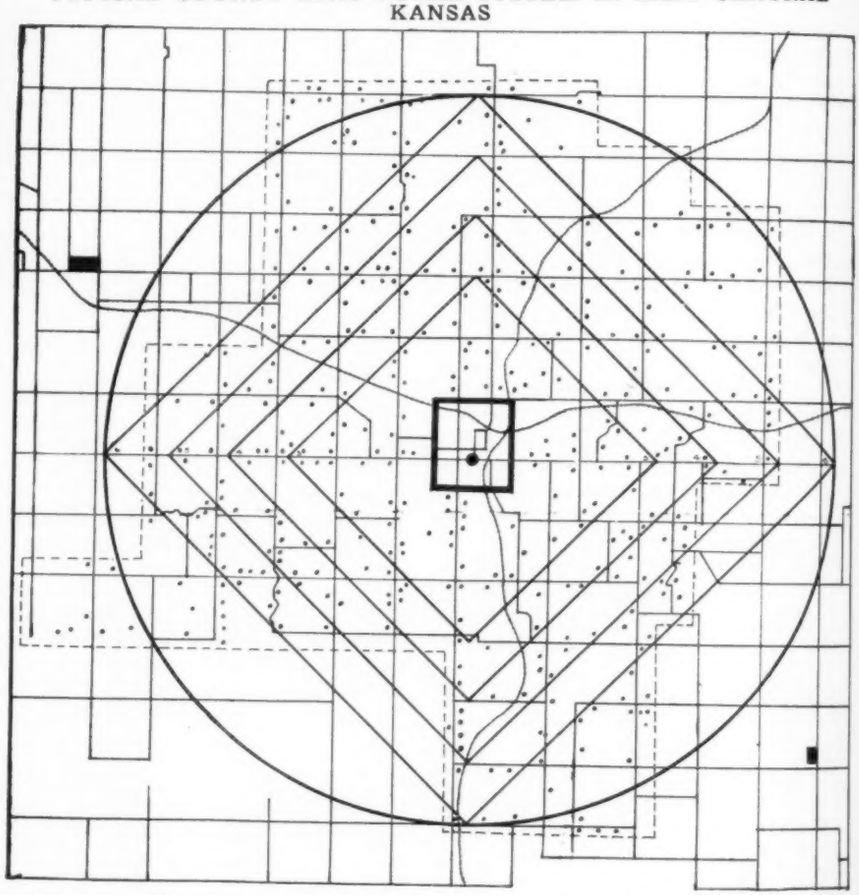


Chart shows 72 square miles served with 332 rural stations which is equivalent to 139 acres per station. Metallic circuits require 1.83 wire miles per station. Scale of chart is 9 square miles per square. Rectangularly zoned. All points on each square are the same distance from central office by nearest practicable route

Legend

- ● rural telephones served
- — — boundary of territory served
- +++ highways
- ▬ surrounding exchanges
- ◆ rural zones, rectangularly measured
- ○ circumscribed circle, 6 mile radius, has an area of 113x1 square miles or 57 per cent more than the 72 square mile area of the 6 mile zone
- □ each square represents 9 miles

especially designed for such lines, they should be removed at once. The industry cannot afford to have common battery service brought into disrepute by those who would attempt to render it on ground return circuits.

It is also necessary to call attention to the fact that where rural lines are multiplied in front of local common battery positions, condenser coupling cannot be used with ground return rural lines, unless the latter be equipped with a repeating coil to prevent the side ground from coupling with the battery ground and ruining transmission efficiency.

Attention is also called to the fact that there is no such thing as a "common return," common battery system. Operation requires that the common return be grounded with the positive side of the battery so that the system becomes simply "grounded" rather than "ground return." All the transmission difficulties above mentioned still remain and it all comes back to the fact, which cannot be too strongly emphasized, that common battery service requires full metallic lines without exception, and that no company should be stampeded into attempting common battery service on lines that are not full metallic.

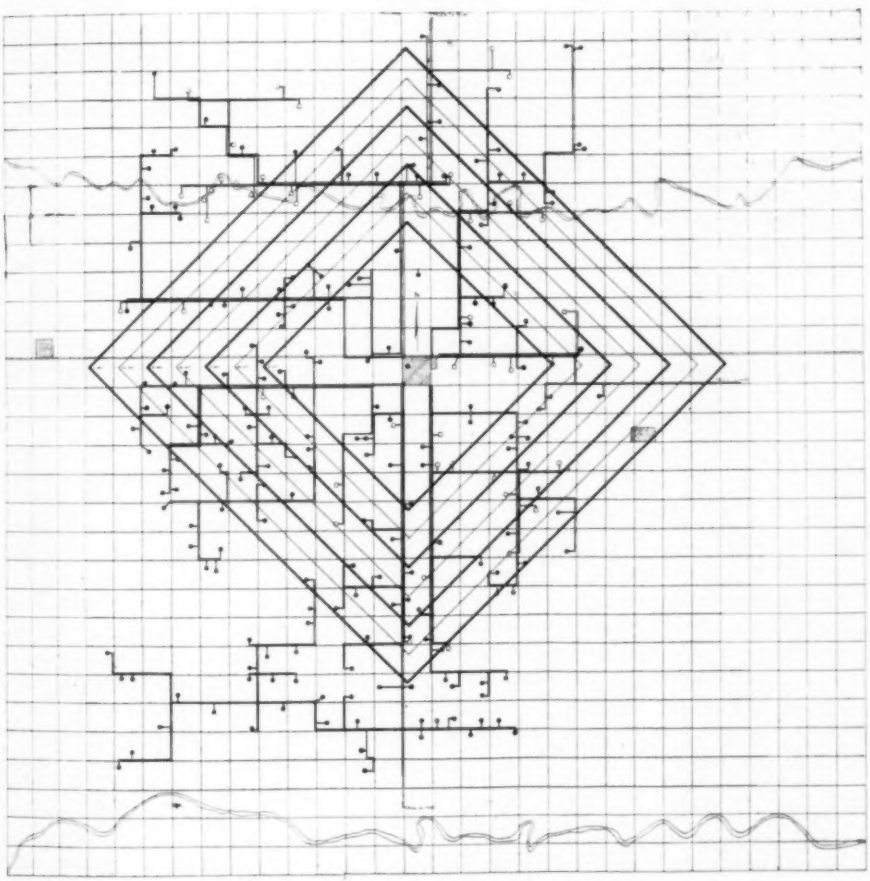
City Lines in Magneto Exchanges

Taking up next the matter of city lines in small magneto exchanges, it must be admitted that high class ground return service can be rendered on open wire distribution, with comparatively short lengths of entrance cable. This is particularly true in the absence of a series street lighting system.

When such existing construction is in good condition it may be allowed to go to the end of its useful life while our time and energies are devoted to more important service needs. Should series street lighting, or a 6,900 volt distribution system in the same alleys, destroy the small town "Telephone Eden" just described, a well built, open wire, ground return village plant need not be wrecked as the old common return or McCluer system is still as potent for such situations as in former days. By adding a non-grounded common return to the existing open wire leads, excellent results may be obtained throughout the life of the existing construction.

But with larger magneto exchanges it becomes increasingly difficult to render satisfactory ground return service. Not only does cross talk increase with increasing cable lengths, but severe power induction is likely to be brought into cables by metallic rural lines made so on account of power parallels. It is rarely practicable to bring the rural lines in open wire to a point near the office, and few indeed are those who have the courage and foresight to keep power noise out of their local cables by the use of line repeating coils at or beyond the cable terminals.

TYPICAL COUNTY SEAT RURAL SYSTEM IN WEST CENTRAL KANSAS



This chart shows 345 square miles served with 236 rural stations, which is 950 acres per station. Ground return lines require 2.63 wire miles per station. Scale of chart is 42 square miles per square. Most remote stations 24 miles from central office by nearest practicable route

Legend

●— rural telephones served
○— rural telephones until recently served by competitive company
—— lines connecting stations to central office
◆ suggested rural zones
▩ surrounding exchanges
□ each square represents 42 miles

Reducing Cross-Talk in Cables

Much experimental work was done in the olden days with a view to reducing cross talk between ground return lines in cable. Needless to say, no satisfactory method was ever found. In ground return exchanges your speaker has little choice between the various systems of grounding so long as pairs are not split and used for two separate lines.

With inductively coupled, repeating coil cord circuits, magnetic induction is largely eliminated by making the system metallic through the cable and grounding the proper side of the pair at the cable terminal.

But electrostatic induction, which is by far the more important factor, remains practically the same as if the line were grounded at the office along with the idle side of all cable pairs.

With either condenser-coupled or single supervisory cord circuits, no noticeable advantage is gained by carrying ground return lines metallic to the cable terminal. The idle sides may be grounded at the central office to distribute a bunch of grounded shielding conductors throughout the cable, but in practice about as good a system as any is to ground at the office and leave all idle cable conductors open at both ends. This results in greatly decreased liability of lightning damage to short cables.

Severe induction in cables carrying ground return lines has often been reduced or almost removed by the careful grounding of the cable sheath, and we believe no attempt should be made to operate, with ungrounded sheath, cables serving ground return telephones.

But since we must leave idle one side of each cable pair, why use ground return lines in magneto exchanges containing considerable cable? The only reason for such practice is to retain in service and exhaust the useful life of good con-

dition open wire leads. Financial considerations often prevent cabling the entire town and in cabling out to meet existing, good condition leads, one is often justified in continuing to use such leads on a ground return basis, with a view always to extending the cable on a full metallic basis when the open wire ground return lead requires replacement. These, in general, are the considerations that have resulted in the almost complete use of ground return lines in Kansas magneto exchanges up to the present time.

Magneto Rural Lines

Reserving the commercial aspects of full metallic city lines until later, we shall next discuss the present rural situation in Kansas as regards metallic versus ground return lines.

The percentages of metallic, "mixed" and ground return lines in Kansas have already been stated. So far as the Independent companies are concerned, the ground return rural line is still the prevailing type and the few metallic and mixed lines have been established almost wholly on account of inductive interference.

For years Kansas rural lines were operated on the theory that the ground return line was standard and that in case of inductive interference the power company must do all things necessary to remove the interference after which the telephone company could *try* to maintain and operate two wire lines at one wire rates. This has led, not only to unprofitable operation, but to actual loss in maintaining and operating rural lines, which are largely or fully metallic, at ground return rates.

	TYPICAL COUNTY SEAT EXCHANGES	
	EASTERN KANSAS METALLIC SERVICE	WESTERN KANSAS GRD. RETURN SERVICE
TOTAL RURAL STATIONS	352	236
TOTAL SQ. MILES SERVED	72	345
AVG. SQ. MILES PER STA.	.22	1.46
AVG. ACRES PER STA.	139	950
AVG. STA. PER SQ. MI.	4.6	.68
RATIO OF STA. PER SQ. MI.	6.8 TO 1	
AVG. WIRE MILEAGE PER STA.	1.83	2.62
AVG. RENTAL PER STA.	2.24	1.75
AVG. SERVICE RENTAL IN EXCESS OF SW. RATE	1.49	1.00
AVG. WIRE MI. SERVICE RENTAL IN EXCESS OF SW. RATE	.81	.38
RATIO OF WIRE MILE RATE	$1.00	47

The power companies have gradually asserted their rights and are now quite generally furnishing additional wire and coils to care for actual parallels only. As an example of how this works out, we might cite a case where, some two years ago, the wire and coils figuring only about $1,000, that even figure was agreed upon and a clear receipt given. But due to the fact that this company's main rural leads are largely on toll pole lines, the entire rural system was so badly noised up with secondary induction, that more than $7,000 has actually been spent to date, with the prospect of another $2,000 being necessary before the lines are effectively quieted.

Ordinarily it would be cheaper to use a separate pole line for the rural system so as to avoid secondary induction from toll lines, but, since one side of the highways is occupied by the power company, it becomes necessary to use the toll pole lines.

From a strategic standpoint this company is worse off from having accepted the $1,000 from the power company. When they get into the inevitable rate case, the fact that they settled for $1,000, and then had to spend $7,000 to $9,000 in clearing the resulting induction, is going to be very embarrassing as the patrons will be inclined to consider the settlement as representing poor management for which they should not have to pay. In the meantime the company finds itself obligated to furnish rural service at a deficit which the city exchange is not able to make up.

This instance is cited to show that, in times past, the more work a company has done to remove inductive interference the worse has been the position in which it has found itself, and years of patient effort will be required to untangle the "jams" which many exchanges are in as a result of placing too much dependence on power company contribution.

Pre-Disturbance Remedies

With the better understanding which the Public Service Commission now has of such matters, we believe less preventive work should be done prior to turning power on a new line or raising voltage on an existing line. With the interference actually established, its extent is not a matter of conjecture and the telephone company has a right to insist on assurance of a compensatory rate before incurring heavy increased capital expenditures to restore impaired rural service to a commercial standard.

While this necessarily subjects the rural line to non-commercial service for a few weeks or months, and also affects city service to and from such lines, it appears the only practicable method of continuing disturbed rural service on a remunerative basis. The wonderful appreciation of metallic service following a few months of non-commercial service, from noised up lines, fully compensates for the bad service endured during the interim.

The duty of the telephone company is to maintain the highest practicable grade of ground return service, at ground return rates, but in our opinion this does not mean that the company is obligated to make large additional capital expenditures without assurance of a compensatory rate.

Use of Metallic Rural Filings

If a metallic rate is on file, and it appears necessary to make a certain line largely metallic because of power induction, the telephone company would seem justified in declining to set up an irregular mixed line condition involving high maintenance. It would be justified in insisting that the entire line be made metallic at the regularly filed metallic circuit rate.

In cases where the trouble can be cleared by making only a small part of the line metallic, the telephone company will, in many cases, be better off at present to set up a mixed line and continue all patrons at the ground return rate. But in so doing they must recognize that they are only putting off the day when the issue must be faced as the mixed line rarely affords a permanent or satisfactory solution.

The foregoing recommendation to get full metallic rural lines, where changed conditions render it impracticable to render ground return service of commercial quality, we believe is fully in accord with the Kansas Commission's tentatively proposed "STANDARDS FOR TELEPHONE SERVICE." Therefore, we hope to see the mixed rural lines, now almost as numerous as full metallic rural lines, rapidly eliminated from the picture as the mixed line is usually an unremunerative compromise between ground return and full metallic service and at present must be operated at ground return rates.

The metallic rates filed during the past year by many Kansas companies should be of great help in clearing up future conditions. But in exchanges where both ground return and full metallic service is now being rendered at the same rate, a specific order from the Commission appears necessary before the metallic filing can be effective. Numerous towns will therefore require rate cases before present chaotic conditions can be cleared up. While this to some extent penalizes the party who has tried to give good service by making use of metallic instead of mixed lines, the ruling is perhaps necessary to enable the Commission to function as required by statute and we do not believe that in the end the Commission will penalize anyone for having tried to give metallic service at ground return rates.

Eastern vs. Western Kansas

The filed metallic rates, if applied as inductive conditions appear, and as old lines rust out, should ultimately take care of the eastern portion of the state. But these rates do not provide an adequate solution for the rural telephone

problems of western Kansas.

At the Kansas convention, two years ago, the writer presented two typical maps to show the necessity of zoned rural service. Since that time the zone idea has been adopted by the more progressive companies as a basis for their future conversion from ground return to metallic service. This is in accordance with the commission's recommendations to get to metallic rural service as rapidly as economic conditions will permit its voluntary acceptance by rural patrons.

Of the two exchanges formerly shown, as in the original charts shown here, the smaller area exchange (in Eastern Kansas) has since filed metallic circuit rates and is prepared to change to the better service.

In the larger area exchange (in Western Kansas) competitive conditions have since been eliminated and a unified service is now being given with ground return rural service continued at a flat rate of $1.75 per month, without zoning.

Comparing the typical Eastern Kansas exchange, after its conversion to metallic service, with the Western Kansas exchange retaining its ground return service, develops certain facts illustrating the fundamental difference between Eastern and Western Kansas rural service conditions.

The reluctance of large operating companies to tackle Western Kansas rural conditions is not hard to understand. Commercially served patrons in thinly settled localities have not been brought to see what they are really getting for their money. The large area exchange cited, where patrons are now paying but 38c per wire mile per month, now has a petition before the public service commission seeking a reduction in rates regardless of the low density of only two-thirds of a telephone per square mile. A reduction to the usual $1.50 per month for ground return service would amount in this case to less than .29 per mile per month above the standard rate for switching service. As every telephone man knows, this condition is absurd anywhere, and especially in a sparsely settled country where the rural pole mileage is perhaps over 50 per cent of the wire mileage figure.

This exhibit is not to be construed as showing metallic rates in Eastern Kansas too high. In fact, they are little if any more remunerative than $1.50 rates for the grade of service commonly given. Nation-wide experience shows that metallic rural service cannot be given at lower rates. The purpose of the exhibit is to show that rural service under Western Kansas conditions had best be left to switcher companies, content to have their lines more heavily loaded for the purpose of cutting down the wire mileage per telephone.

Switcher Telephone Service

With telephones installed by commercial companies and maintained by them when brought to the office, good long distance service can be rendered by switcher lines and the losses sure to be sustained on company ownership of the lines thereby avoided.

When populous neighborhoods, such as river valleys, desire a better service, the commercial companies can undertake to furnish same with metallic service with the understanding such circuits will not be extended to "thin" territory but the latter left for switchers to develop as best they can, with the help and co-operation of the commercial company.

Furnishing first class rural service on a few company owned lines in each exchange is always desirable as an urge to switcher lines to keep their service to a high standard. In the more thickly populated rural districts, where the company could afford to operate the entire rural territory, example is stronger than precept, and a few well placed metallic lines, serving the more prosperous farmers, is the best method of bringing about the voluntary dissolution of rusted-out and hedge-buried switcher lines.

Distinctive Numbers for Switchers

This reminds us that in all exchanges serving switcher lines there should be some method whereby the patron can readily distinguish between switcher and company owned rural lines.

Most small exchanges are now cluttered up with a superfluous "F" inserted as a "break" letter between the line number and the code ring. With the older codes which required two or three signal digits, such break letter was necessary, but with the modern tens-units code system the last two figures give the number of long and short rings, and the first two the rural line number. With the tens-units system, the break letter becomes wholly unnecessary, and may be removed from company owned lines without the slightest confusion.

Thus in all exchanges with less than 1000 city lines, the rural numbers can start at 1000 or 1100 and 1121 can mean nothing except "plug into the 1100 line and give 2 long and 1 short rings." But should the 1100 line be a switcher, allow the number to remain 11F 21 and courteously explain in the directory that all "F" lines are "Farmer's" lines and that on these you cannot be responsible for results.

Even in an exchange of 5999 city lines, forty company owned rural lines, if numbered 60 to 99 inclusive would require no break letter, so that the idea of making the "F" designate *"Farmer's"* lines is practicable in nearly all exchanges.

Patrons are quick to note that poor service results only when they are obliged to call the "F" lines and a powerful sentiment for company ownership is rapidly built up.

"Overselling" Metallic City Service

While every exchange with a filed metallic rural rate should strive to establish at least a few lines to show what rural service really should be, a note of warning must be given against ill advised attempts to sell metallic service as a "cure-all" on individual city lines. When a group of rural people change from ground return to metallic lines, they at once note a great improvement in their service with each other, and even to ground return lines in town. They do not blame the company for poor service to other rural lines. But experience shows the individual line city patron, on purchasing metallic service, expects perfection forthwith, even though his may be the only metallic line in town. For this reason greater care must be used in selling metallic service in town than in the country.

But the elevator man, whose competitors, on the same siding, now listen each time his bell rings, will appreciate secret service on long distance calls and practically secret service on most of his local calls.

Aside from secret service on long distance calls, the up-town business man derives little benefit from a short metallic circuit, for his line alone, and the greatest care must be used not to oversell this idea. Should an overenthusiastic commercial man promise benefits similar to those on a long rural line, the customer is doomed to disappointment for when his metallic line is connected to other ground return lines it is doubtful if he can note the slightest improvement in service or diminution in cross talk. As a result, when we come to convert the entire exchange to metallic, and really give service, this fine progressive patron who was changed prematurely will solemnly declare that he has already tried metallic local service and found it no better than the ground return service formerly given.

How much better to hold back our metallic city service until at least the entire business district decides that secret service is desirable on long distance and business calls and accepts the improvement.

Residence subscribers may then be assured private talks to the business district and to the doctor's residence also, if he has been provided with a metallic circuit. In fact, private conversations can be had not only with the business district but with all other high class residences which have metallic service.

On the latter program it is possible to get somewhere with an optional metallic city rate, but never if we kill the idea by promising everything to a few individual patrons who first make the change.

THE TECHNICAL CLEARING HOUSE

B. C. BURDEN, Editor

Eavesdropping Subscribers.

Q.—What transmission loss is caused by eavesdropping subscribers on rural lines?

A.—Actual measurements show that each eavesdropping subscriber causes approximately a 3 db transmission loss to the normal connection. The effect of a variable number of eavesdropping subscribers is approximately as follows:

No. of eavesdropping subscribers	Loss in DB.	Transmission efficiency compared to no eavesdropping condition.
0	0	100%
1	3	50%
2	6	25%
3	9	12½%
4	12	6¼%
5	15	3⅛%

Another way of considering or explaining the excessive loss due to eavesdropping is to state that each eavesdropper causes the same transmission loss that would be introduced by adding ten miles of No. 12 (.109) metallic iron wire to the circuit.

Operators Training Time.

Q.—How many months are required before the average student operator may be considered as having obtained her maximum efficiency?

A.—The time required for an operator to obtain maximum efficiency naturally varies quite widely and depends upon training methods, amount of traffic handling, and the personal ability of the operator.

The following figures have been worked out by one company as representative of the time required for a beginning operator to obtain full efficiency in a medium size office. End of first month (56%), end of 2nd month (74%) end of 3rd month (81%), and 100% at the end of ten months.

In this connection it is interesting to note that one large operating company has stated that it costs them $1,000.00 to lose an operator.

Resistance vs. Unit Leak.

Q.—Some companies express leakage of toll lines in terms of "unit leaks per mile" and others express it in terms of "megohms per mile." What is the basic difference between the two methods and which is preferred?

A.—"Megohms per mile" expresses leakage in terms of the insulation resistance in millions of ohms (megohms) per mile of circuit. The leakage is determined by measuring the resistance to ground or between wires and multiplying by the number of miles. For example a circuit ten miles long which showed a resistance of one megohm would be said to have an insulation resistance of ten megohms per mile.

The "unit leak" is an arbitrary unit and may be defined as equal to one millimicro-mho. It should be noted that this unit expresses conductance rather than resistance. The number of unit leaks per mile leakage on a toll line is determined by measuring the resistance in megohms and dividing this into 1000; the result in unit leaks is then divided by the number of miles of circuit to get the leaks per mile. For example, a circuit ten miles long showed a resistance of 1 megohm would be said to have a leakage of $\frac{1000}{1}=\frac{1000}{10}=100$ unit leaks per mile.

Those championing the "unit leak" point out that it is the most logical method of expressing line leakage inasmuch as a high figure represents excessive leakage whereas a lower figure less leakage. In the insulation resistance method the higher the megohms per mile the lower the leakage.

The writer favors the insulation resistance method inasmuch as it expresses leakage in terms of standard units.

Heat Coil Resistance.

Q.—What is the resistance of present day low loss heat coils?

A.—The resistance of modern heat coils ranges from 2.5 to 3.5 ohms. Old style coils were much higher than this, some types running as high as 40 ohms. Main frames equipped with the old style composition coils should be tested with an ohmmeter to insure that the resistance has not increased above its normal value. This type coil has a tendency to "go high" after having been in service for a period of years.

Cable and Wire Resistance.

Q.—Please give the resistance per circuit mile of the common types of cable and open wire used in telephone plant.

A.—The resistance of cable and open wire are as shown below.

Wire or cable.	Gauge.	Diam. in mils.	Cct. ft. per ohm.	Ohms per 1,000 cct. ft.	Ohms per cct. mile.
Copper wire	8 B & S	128	790	1.266	6.68
Copper wire	12 NBS	104	521	1.916	10.12
Iron wire	10 BWG	134	129	9.760	41.02
Iron wire	12 BWG	109	78	12.860	68.86
Cable	19 B & S	35.89	61.5	16.250	85.80
Cable	22 B & S	25.35	30.7	32.500	171.60
Cable	24 B & S	20.10	19.5	51.540	271.00

Rectifying Joints.

Q.—We have observed that radically different resistance readings may be obtained in measuring on toll lines if the d. c. measuring current is reversed. What is the cause?

A.—Different resistance readings are possible on copper toll line measurements when a badly corroded splice is in the circuit. The splice may under certain conditions act in a manner similar to the "copper oxide type" rectifiers, thus offering a low resistance to currents flowing in one direction but high resistance to currents flowing in the opposite direction. The resistance of such a circuit as indicated by a d. c. meter would obviously depend on the direction of current flow in the circuit.

SELL TRI-STATE PROPERTIES TO NORTHWESTERN BELL

Sale of the Tri-State Telephone and Telegraph company, operating in St. Paul, Minn., and in the southern section of Minnesota, to the Northwestern Bell Telephone company, operating in Minneapolis, Minn., and surrounding territory, which has been awaiting approval of the Minnesota Railroad and Warehouse commission for a number of months, has been given the conditional approval of the commission.

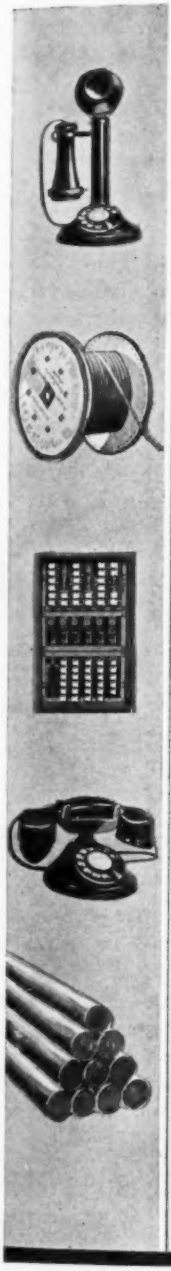
The condition upon which the sale was called official by the commission is that the Bell company, which will operate the exchange in both cities, shall lower the rates.

The transfer of stock must be approved by the interstate stock commission, which will require from 60 to 90 days.

The price paid is $18,500,000 and the Bell company will spend $250,000 in changing equipment in Minneapolis and St. Paul.

SHANGHAI, CHINA

Shanghai's New Dial Telephone System Will Be of Strowger Manufacture. This Equipment, as Made in the Strowger Factories at Chicago and Liverpool, Is Used in Many Other Large Cities in China.



Shanghai, City of Contrast— Now Uses the Strowger Dial

SHANGHAI'S progress has been so rapid that the new and the old stand in a thousand vivid contrasts to each other. This comparison is further heightened by the fact that throughout China the complete change from the old to the new is taken with no gradual steps intervening.

For this reason, when the officials at Shanghai sought to modernize that city's telephone system, they based their selection on no pre-conceived ideas. They purchased Strowger Dial equipment because it was the FINEST available and they based their conclusions on the opinions of foremost telephone engineers in every part of the world.

Other telephone administrations will find it profitable to follow this example and select Strowger equipment to modernize their telephone systems. The world-wide organization of The Automatic Electric Company, Ltd., makes it easy and economical for a telephone company anywhere to change to this preferred service.

In addition, this company supplies every kind of telephonic and line equipment. Call on us for a convenient, quality-assuring solution to all your equipment problems. Your request for a quotation or a representative's call will be given immediate attention.

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•

STROWGER AUTOMATIC DIAL SYSTEMS

MANUAL TELEPHONE EQUIPMENT

ALTON STORAGE BATTERIES

PHILLIPS WIRES AND CABLES

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DRY BATTERIES

POLES

and other high quality products in the signal and communication field.

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Distributors of
Dial and Manual Telephone Systems—Private Telephone Systems—Telephones
Wires—Cables—Poles—Batteries—Supplies—Etc.

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Automatic Telephone Manufacturing Co., Ltd., Liverpool
The New Antwerp Telephone and Electrical Works, Antwerp
Eugene F. Phillips Electrical Works Limited, Montreal

Emergency Listening Circuit Functions

Cut-In Key Useful for "B" Operator to Check Connection and Determine if Audible Ringing Is Functioning, According to John H. Levis, Jr., Telephone Engineer, Rochester, N. Y., in the Thirteenth Installment of a Series of Articles on Straightforward Trunking

Each incoming trunk circuit is equipped with a non-locking push button key which is used by the "B" operator when it is necessary for her to cut in on a trunk on which there is an incoming call showing. An example of this is a trunk that is not operated by the automatic cut-in portion of the trunk circuit.

The failure to cut-in automatically is indicated by a steady incoming signal light. This condition may exist on all trunks in a "B" position or only on one or two trunks. However, when all of the trunks, except the one or two, are operating automatically and are being passed by the sequence cut-in circuit, the "B" operator uses the emergency cut-in key.

The cut-in key may be used for monitoring on a "B" trunk. This key is useful at times in that the "B" operator can check up on a connection just completed and determine if the audible ringing is functioning and if connections are satisfactory. It is also used to supervise on trunk connections that are up for a long time and to determine if a connection is still established or abandoned and if the supervisory lamp circuits have failed.

In describing the emergency cut-in portion of the trunk, only that part of the trunk circuit involved is shown in the accompanying circuit diagram because the automatic cut-in portion of the trunk has been described in a previous issue of TELEPHONE ENGINEER.

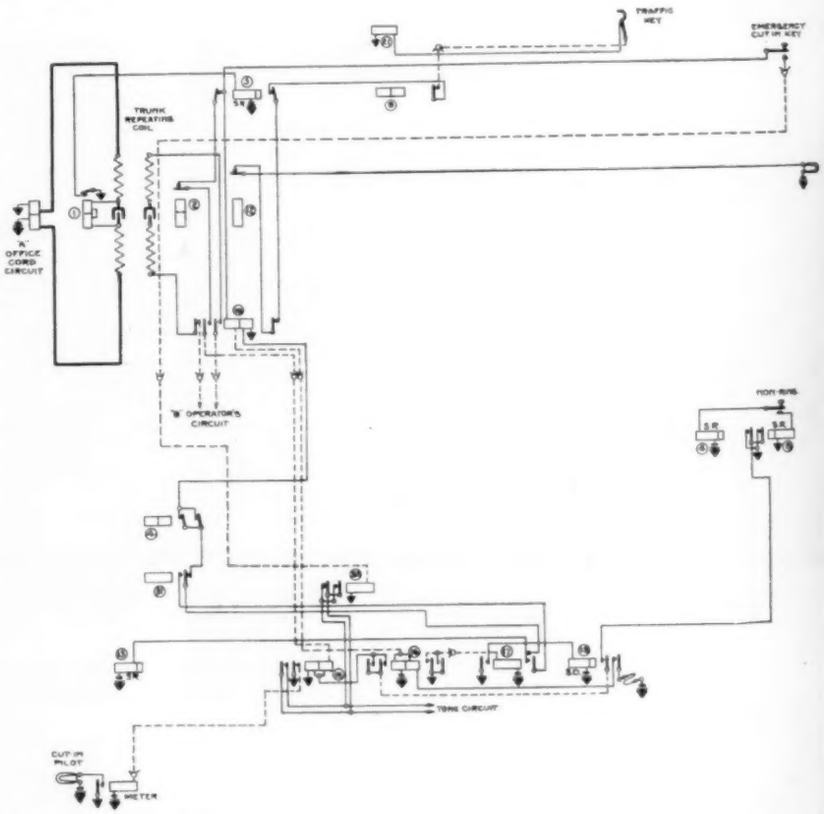
An incoming call in a "B" position is initiated in the usual manner. The "A" operator plugs into an idle outgoing trunk with an "A" cord circuit, which operates the No. 1 relay and which in turn operates the No. 3 slow release relay. This causes the sequence circuit to function and it cuts in the No. 10 operator's cut-in relay. Let us assume that the No. 10 relay does not operate with the above relay operations. It will be noted that the trunk lamp signal will light steadily from low resistance ground of relay No. 21 through the operated traffic key and through relays No. 3, No. 10 and No. 12 to the trunk lamp to battery.

The No. 3 relay closes the cut-in key circuit winding of the No. 10 relay through the non-operated battery supply relay No. 2 to contact of the No. 10 relay (non-operated) to the Hi-Lo relay No. 15 of the common circuit to ground. The other side of the winding of the No. 10 relay is connected to the Hi-Lo relay of No. 16 of the common circuit to battery.

The operation of the cut-in key places ground from the No. 30 common relay winding to the winding of the No. 10 relay and through it to the No. 16 common relay (high winding) to battery, causing the No. 16 relay to operate. The No. 10 cut-in relay will not operate until the No. 17 relay and the No. 18 relay operate. When the No. 18 relay operates and places the non-inductive coil with battery connected to it in series with the low resistance winding of the No. 16 relay which is in shunt with the high resistance winding, the current through the No. 10 relay winding is increased, allowing the No. 10 cut-in relay to operate. When the No. 10 relay is operated the locking path is closed through to the No. 15 common relay of low resistance ground. The high resistance winding of the No. 15 relay is shorted out when the No. 16 and No. 18 relays are operated, obtaining ground from the non-operated relay No. 18 associated with the non-ring master key.

The No. 10 operator's cut-in relay is now operated. The trunk lamp signal is flashing and the call passing tone is projected to the distant "A" office. The "B" operator's circuit is connected to the "B" trunk. The circuits of the above operations have been described in previous issues of TELEPHONE ENGINEER. With the common cut-in relay circuits in this condition, no other trunk circuit can cut in automatically because the low resistance common relay No. 13 is open at the No. 17 relay as far as a connection to relay No. 4 sequence control relay is concerned. This connection passes through contacts of the No. 31 common relay.

The "B" operator now pre-selects with the non-ring key. The operation of the common master key relay No. 8 (slow release) opens the ground that is shorting the high resistance winding of the No. 15 relay allowing the high resistance to be placed in series with the emergency winding of the No. 10 relay, causing it to release. The operator is taken from the circuit, and the other parts of the



Circuit diagram showing portion of emergency cut-in key circuit of straightforward trunk

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YOU CANNOT LOSE

Most every telephone man knows about the Coffey System-Central Accounting Department—many have been using it for years. If you don't know how it can save you money and place your accounting second to none, write today for particulars.

Heretofore, the drawback to the smaller Company was the expense of getting started, but we have now arranged to handle this without expense to you, and your charge begins only after we have actually turned out your first month's statement. If at the end of the first year you are not satisfied, all records are returned in an up-to-date condition.

The Chairman of the Indiana Public Service Commission said, "It would seem to me that you have not made your Central Accounting scheme plain, or the building you are in would not be large enough to handle the business."

It costs you nothing for full particulars and it will be our pleasure to furnish them.

COFFEY SYSTEM & AUDIT CO.

Consolidated Bldg.

Indianapolis Indiana

Reduce Your Ringing Cost

Size 12"x9"x5"
Weight 15-lbs.

ONE MOVING PART!
ONE CONTACT!

IN WORLD-WIDE USE

TELERING

THE SUPER-RINGING MACHINE
MEETS ALL THE REQUIREMENTS OF GOOD RINGING SERVICE

Don't allow the low price to adversely prejudice you.

MORE POWER—LESS ATTENTION

A Trial Order will convince you; if not, return it and we will pay the expressage.

Suitable for the largest Central Office or the smallest P. B. X.

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INSTALL IT — THEN FORGET IT
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common circuit involved (the No. 16, No. 17 and No. 18 relays) also release. This condition also allows any other trunk that was standing in to be cut in automatically as the No. 13 relay winding is closed to the sequence circuits by the release of the No. 17 relay.

With the trunk circuit operating normally the No. 16 common relay does not operate because the high winding of the No. 16 relay will not operate through the high resistance winding of the No. 15 relay, but the No. 15 relay will operate. The D. C. resistance values of all trunk and common relays have been shown in previous installments.

The No. 17 relay operates in a local circuit from the No. 16 relay and opens the winding of the No. 13 relay. The opening of the No. 13 relay from the No. 4 sequence cut-in control relay of the trunk circuit causes the No. 10 relay (operator's cut-in) to release. This condition exists only when a trunk circuit has been cut in automatically and the cut-in key is operated on some other trunk circuit that the "B" operator desires to take care of. With the No. 17 relay operated a local circuit is closed to the No. 18 relay (slow to operate). This relay is made slow to operate in order that sufficient time is allowed for the first No. 10 relay to release before the low resistance ground and battery circuits are closed at the No. 18 relay. This condition makes the No. 15 and the No. 16 relays low resistance relays and, therefore, the No. 10 cut-in relay operates in the trunk in which the cut-in key is operated. The No. 10 relay locks in and it is not necessary for the "B" operator to hold the cut-in key operated.

In the event the "B" operator elects to supervise a trunk circuit that is up, with the connection established and with the No. 2 battery supply relay operated, it will be noted in checking the circuit diagram that the locking circuit for the No. 10 relay will be open and it will be necessary for the "B" operator to hold the cut-in key operated in order to keep her circuit across the trunk circuit.

The call passing tone will not be placed across the trunk talking circuit in this operation because the No. 15 common relay with the tone control on it will not operate. The No. 30 common relay will operate from the cut-in key operation which also opens the tone control circuit. The No. 16, No. 17 and No. 18 common relays will operate but they will not lock in pending release by operation of the non-ring master key, but will release when cut-in key is restored to normal

The cut-in pilot and peg count meter circuits function only when the No. 15 common relay operates either from the cut-in key operation or from sequence cut-in control circuits as in the standard operation.

It Pays to Use the Best Equipment

Another New Kellogg Masterbuilt Switchboard Chosen by Mr. Hite of the Farmers Mutual Telephone Company, for the Toms Brook, Virginia Exchange

M. Lloyd Hite of the Farmers Mutual Telephone company, Edinburg, Va., is a real booster for Kellogg switchboards and telephone apparatus. He has just recently ordered his sixth Kellogg switchboard.

Mr. Hite is plant manager of the Farmers Mutual Telephone company and in this capacity he is invested with the responsibility of purchasing the equipment and apparatus that best suits the requirements of his company and that will earn the greatest returns.

Mr. Hite endeavors to place the finest equipment wherever possible and, to quote him, "he is keen to acknowledge and appreciate the class of material and workmanship that goes in every piece of Kellogg apparatus." He has installed a great number of telephones—all of them Kellogg instruments—and in every case they have given perfect satisfaction.

In 1925 the Farmers Mutual Telephone company purchased and installed their first double-lamp supervision board—a 150-line Kellogg job—in the New Market, Va., exchange. At that time Mr. Hite was rather hesitant, inasmuch as he had had no great amount of experience with any but the straight circuit type of board. The relays, coils and lamps looked rather complicated, but his fears soon disappeared. Up to the present he has had absolutely no trouble with the double-lamp supervision board, and it has proved to be far superior to the old type. All the supervisory lamps of this board, now six years old, are still working perfectly and the only replacement made was that of a coil burnt out by a bolt of lightning. Mr. Hite and his associates are of the opinion that lamp supervision is far superior to anything they have ever tried. The same type of Kellogg board was installed in the company's Strasburg exchange a few years later. At the same time Mr. Hite sold the First National bank of Strasburg a Kellogg P.B.X. which added a nice sum to his company's revenue. A few weeks ago another Kellogg 100-line board was installed at the company's Toms Brook exchange.

M. Lloyd Hite, Supt. of the Farmers Mutual Telephone Co., Edinburg, Va., is a strong booster of Kellogg equipment.

The many years of telephone experience that Mr. Hite has accumulated is reflected in his fine work of superintending the Farmers Mutual Telephone company's line construction, installations and maintenance of all plant properties.

The company, because of the progressiveness and foresight of its personnel, is building a fine, strong institution in Virginia. The company's executives have found that good equipment quickly pays for itself because it enables them to render the best service possible to their subscribers with a minimum maintenance cost. The Farmers Mutual Telephone company's record of success, and Mr. Hite's long experience in the telephone business have certainly proved that the best equipment pays from beginning to end.

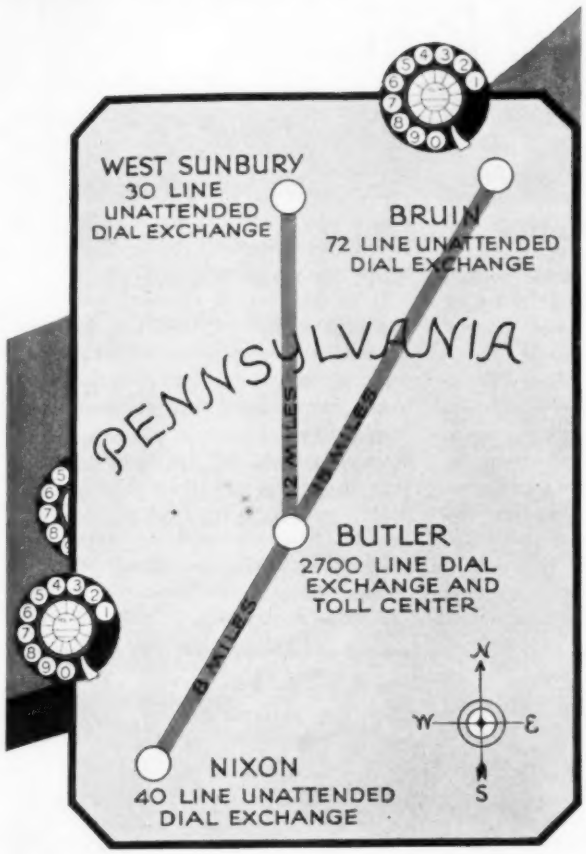
TERMINAL BOX IS MEAT FOR WOODPECKER

Scores of complaints in Seattle, Wash., recently sent telephone linemen into a certain district to determine what was causing telephones in that vicinity to go dead. A search showed that woodpeckers had bored through a terminal box and had thereby short-circuited the lines.

A study has revealed that woodpeckers prefer boxes painted green but will not disturb those painted white. But when the white paint begins to wear off or becomes dull, the birds go to work.

WE HAVE MOVED

Editorial and advertising offices of TELEPHONE ENGINEER, for the last several years located at 192 N. Clark St., Chicago, have been moved to larger and more centrally located quarters, at 185 N. Wabash Ave., Chicago. The telephon remains the same, State 8971.



The Strowger Dial Network of the Peoples Telephone Corporation of Butler, Pennsylvania, Illustrates the Modern Method of Servicing Small Communities. Special Services for All Four Exchanges Are Handled at Butler.

MODERN SERVICE VIA THE STROWGER DIAL

THE problem of providing modern, day and night service to small outlying communities and suburbs, has always been a trying one for telephone executives. Under former methods of operation, to supply satisfactory service meant almost invariably a financial loss. The larger exchanges were made to bear the burden of the smaller.

Even the smallest exchanges can be made to stand upon their own feet financially — and at the same time provide the finest type of telephone service known. Compact, sectional type Strowger units—self-operated—make this possible. The feasibility of unattended dial operation for small exchanges is proven by the hundreds of them in daily, PROFITABLE, operation—while the almost overwhelming trend toward the dial during the last few years, has indicated that this method of operation is already accepted as standard throughout the world.

Why not begin planning for the modernization of your exchanges now? Today is none too soon—and the profit-making possibilities of Strowger operation for your properties may prove to be a pleasant surprise.

Automatic Electric Inc.

Manufacturers of
STROWGER AUTOMATIC DIAL TELEPHONE AND SIGNALING SYSTEMS
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Eugene F. Phillips Electrical Works Ltd., Montreal

Japanese Telephone Man Seeks Assistance in Solving Technical Problems

Editor's Note—The letter shown below was received from one of our Japanese readers located on the Island of Karafuto, which is the most northern of the five principal Japanese Islands. Karafuto is in approximately the same latitude as Newfoundland. The population of this Island is approximately 150,000. It is interesting to note the difference in the construction methods used in Karafuto and those in this country.

The answer to the letter prepared by B. C. Burden, TELEPHONE ENGINEER'S Technical Editor, is also published here.

Naimubu-Teishinka,
Karafuto Govt.,
Toyohara-Machi,
Karafuto, Japan.

Telephone Engineer,
192 N. Clark Street,
Chicago, U. S. A.

Gentleman:

Words fail to express my gratitude for your extraordinary kindness so often. My position is now concerns of underground cable, and city line. Though I am very sorry to trouble you, if you inform me my questions, I shall esteem it a favor.

I have laid cast iron pipe in the ground at Otomari in 1928, but that pipe is broken by expansion of freeze, and all underground cable faulted every year. (Please compare with sketch and photograph.)

Inform me, if you know a fault as same as our fault in America and its prevention method.

Please send me a book of construction of city line and cable work, if you can.

Therefore, inform me new construction of underground work, please.

Yours truly,
SABUROW SAKURADA.

Mr. Saburow Sakurada,
Naimbu-Teishinka,
Karafuto Gov't, Toyohara-Machi,
Karafuto, Japan.

Dear Sir:

Your letter of March 1st, addressed to TELEPHONE ENGINEER, relative to trouble you are having with cast iron underground conduit, and requesting information on American construction methods has been referred to the writer for reply.

It is my opinion that the breaking of your cast iron underground conduit results from exceeding the tensile strength of the pipe as a result of low temperatures, with the resulting lengthwise contraction of the pipe which is rigidly fastened to manholes at each end.

I suggest that this trouble could be eliminated by removing a small amount of concrete from around each conduit at the point of entrance to the manhole, and packing the space between concrete and conduit with a tarred hemp or mastic compound. This will permit the conduit to contract without exceeding its tensile strength and should effectively prevent water from entering the manhole.

It is the practice in this country to lay cast iron water mains, and in some cases cast iron gas mains, in the ground below the frost line without any provision for contraction and expansion due to temperature changes other than assuming that the lead caulked joint between individual pipe lengths will provide for some movement. Inquiry develops that no trouble is experienced from pipe breakage due to low temperatures.

Welded steel gas pipes are placed in the ground above the frost line with no provision for contraction other than the pipe being placed irregularly in the trench which provides for the anticipated contraction. Steel, of course, has a much higher tensile strength than cast iron.

It is the opinion of those who have had considerable experience with underground pipe structures, that cast iron pipes which are subjected to considerably lower temperatures than those at which they are placed in the ground should not be rigidly held at their ends, that is some lengthwise movement should be permitted otherwise the contraction due to low temperatures might be sufficient to exceed the tensile strength of the pipe.

Your letter gave the impression that you think it necessary to make an under-

(*Continued on page* 48)

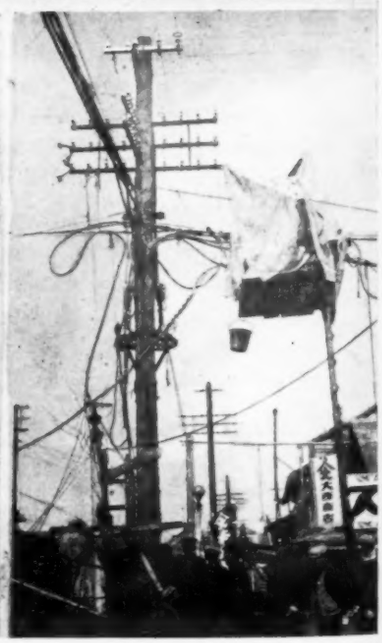
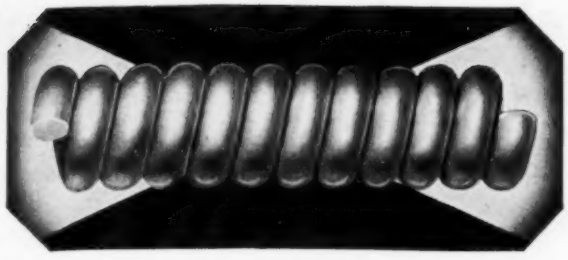


Fig. 1 *(top)—Section of open trench covered because of heavy rains*
Fig. 2 *(lower left)—Broken conduit covered by contraction*
Fig. 3 *(lower right)—Underground riser pole showing temporary cables used while repairing underground cables*



Galvanized Telephone Wire and Steel Strand

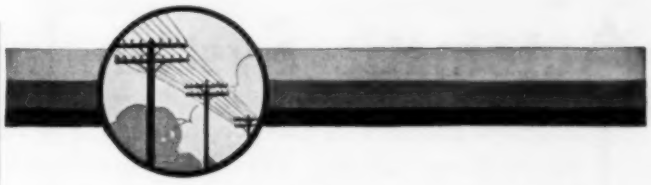
Crapo Galvanized Wire can be wrapped around its own diameter without injury to its pure zinc coating....That is one of a number of reasons why **Crapo** Galvanized Telephone Wire and Strand can be depended upon to reduce maintenance cost.

Look for the **Crapo** Seal!

Indiana Steel & Wire Co.
Muncie, Indiana

INDIANA STEEL & WIRE CO. Crapo Galvanized MUNCIE, IND.

Crapo
GALVANIZED PRODUCTS



AN ORGANIZATION OF EXPERTS

IN the manufacture of any product, there are invariably certain things relating to design, to the quality and relative proportions of component materials, to the various processes of practical fabrication—which can be learned only by experience.

The manufacture of wires and cables is no exception. For telephone cables, for magnet wire, for power conductors—uniform conductivity, proper tensile strength and unfailing, durable insulation are of the highest importance.

For such products, experience is a prime requisite. For forty years this company has been in the business of manufacturing wires and cables—of every kind and for every purpose. Our employees are experts, trained to value quality above all else. As a result, the name Phillips has become a synonym for excellence, a guarantee of durability and quality. We will be glad to submit prices and specifications upon request.

We are manufacturers of—

Bare and Insulated Copper Wires—Rubber Insulated Wires—Enameled Wire—Magnet Wire—Power Cables—Switchboard Cables—Paper Insulated Cables—Flexible Cords—Electrolytic Copper Rods, Shapes, etc.

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FACTORIES—MONTREAL AND BROCKVILLE
BRANCHES—WINNIPEG, TORONTO, REGINA AND VANCOUVER

Automatic System Installed in Hong Kong

Siemens Brothers of London, England, Provide New Equipment for Three Exchanges of Hong Kong, China. Ultimate Capacity of Area Totals 20,500 Lines. Apparatus Supplied with Special Tropical Finish as Precaution Against Humid Climate Conditions

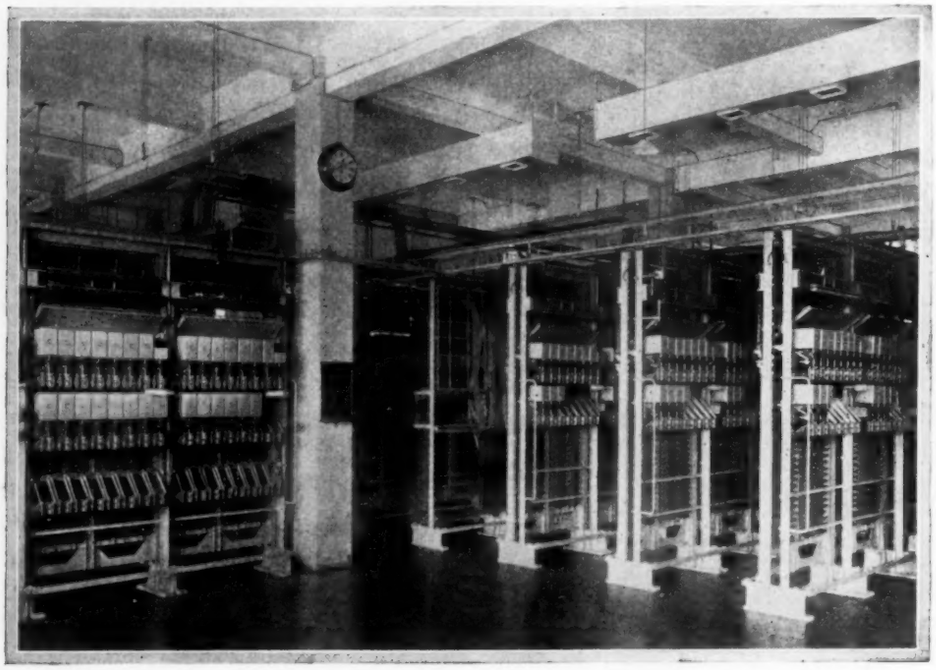
An important forward step in modern telephone development is exemplified in the case of the Hong Kong Telephone company which has recently adopted the step by step automatic system.

The new automatic equipment was manufactured and installed by Siemens Brothers & Co., Ltd., of London, England, and is similar to that supplied by them to the British Postoffice.

The Hong Kong Telephone system comprises a network of three exchanges—Central, Kowloon and Peak—with an initial equipment for a total of 12,900 lines, the whole of which were successfully cutover to automatic service at midnight on May 3, 1930.

The ultimate capacity of the area totals 20,500 lines, in addition to which Central exchange has capacity for accommodating a further 10,000 line unit.

Direct junctions are provided between the two main exchanges, Central and Kowloon, and between Central and Peak, but calls between Kowloon and Peak are routed via Central exchange. Kowloon, which is located across the bay five miles from Central exchange, is connected thereto by submarine cable. Peak exchange is arranged as a discriminating satellite on Central, local calls being completed without occupying a junction. In order to meet the requirements of the exceptionally humid climatic conditions prevailing in Hong Kong, the manufacturers adopted the precaution of supplying all apparatus with a special tropical finish.



Central Exchange, Hong Kong

A toll board, also manufactured by Siemens Brothers, is at present being supplied and in the first instance will provide for long distance service with Canton.

At Central exchange inquiries and complaints are centralized on a six position monitor's desk, while centralized service observation for the whole area is provided on a service observation desk in the same exchange.

Duplicate 50V. batteries, motor-generator sets and ringing machines are supplied for all exchanges, with the exception of Peak where one motor-generator set only is provided.

ANNUAL REPORT ON WOOD PRESERVATIVES

The 1930 annual report on the quantity of wood treated and preservatives consumed in the United States, prepared by R. K. Helphenstine, Jr., of the U. S. Forest Service, in cooperation with the American Wood-Preservers' Association, just released, shows a gross decline of but 8 per cent in amount of timber treated in 1930 compared with the previous year. The total output of treated timber for 1930 reported by 204 treating plants was 3,987,822,924 bd. ft., compared with 4,344,108,564 bd. ft. in 1929.

Three-fourths of this volume decrease was in crossties alone, the volume of which may be expected to decrease each year by reason of the longer life being obtained from treated ties in service, and consequently less renewals. Eliminating this item from the figures for 1929 and 1930, there is shown a net decline in 1930 of only 4 per cent from the 1929 peak figure, which was the culmination of a gradual increase in production dating from 1922, during which period the output of treated timber was multiplied about 2 1/5 times. Considering the depressed condition of business in general during 1930, and extending into 1931, it is apparent the wood-preserving industry suffered considerably less decrease in normal output than most other industries in this country.

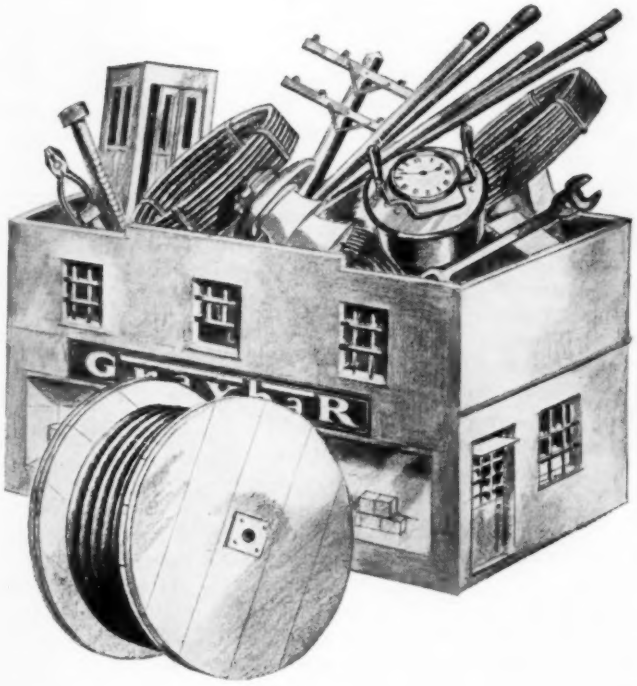
Creosote and zinc chloride were used for treatment of 98 per cent of the total timber treated in 1930, compared with 98.8 per cent of the previous year. A total of 213,904,421 gallons of creosote and creosote coal-tar solution was used in 1930, or 12,469,806 gallons less than in 1929.

The number of southern pine poles given pressure treatment increased from 2,006,500 in 1929 to 2,428,001 in 1930, an increase of 21 per cent. The number of poles of other species given butt treatment, however, decreased from 2,311,815 in 1929 to 1,817,227 in 1930, or 21.4 per cent.

More pine poles were treated in 1930 than the combined number of all the other treated species.

It is interesting to note that this is the fourth year that creosoted pine has led the field of treated poles, and also that in a year of decreasing markets, treated pine made its greatest stride forward.

for every telephone need



Cable

...and 60,000 other items

WHERE dependability counts—only the highest quality electrical products will do. One such quality product is Western Electric Lead Covered Cable—a cable whose dependability is insured by the most exacting of manufacturing standards.

But that's not all. Out of its roster of 60,000 electrical items, Graybar is prepared to meet *any* need of a telephone industry. And behind *every* Graybar item stands the Graybar reputation for quality that goes back 62 years.

GraybaR

OFFICES IN 76 PRINCIPAL CITIES

EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK, N. Y.

Carry An Accurate Pocket Ohmmeter For Circuit Testing Of All Kinds

JEWELL

The Jewell Pattern 89 Ohmmeter provides a simple means for quickly and accurately checking or making resistance measurements on all outside lines and central office circuits.

It is completely self-contained, very light in weight, and is easily carried in a pocket. A standard 1½ volt flashlight cell within the case provides the necessary potential. Accurate measurements are assured by a simple screw adjustment that compensates completely for any change in battery voltage.

The Jewell Pattern 89 Ohmmeter is available in single and double range models, with ranges expressly designed for telephone testing.

Write for detailed information concerning this useful instrument.

Pattern 89 Ohmmeter
Single Range

Full Size Scale, Single Range Ohmmeter

Jewell Electrical Instrument Company
1650 Walnut Street, Chicago, Illinois

A True Gauge of Toll Traffic

THE Calculagraph is not only a vigilant guardian of toll board revenue, but also an accurate gauge of traffic. The toll tickets recorded by the Calculagraph provide a clerical measurement of toll income down to the last cent, and every penny is always accounted for. Managers also find these records a daily index of their traffic flow—convenient, certain, easy to check up in the brevity of the useful information summed up.

The Calculagraph stamps on the toll ticket the beginning of each call together with the time elapsing during each call, down to the quarter of a minute, for any number of calls—producing a permanent and accurate record of each.

Prices and Information on Request.

THE CALCULAGRAPH COMPANY
50 Church Street Dept. 22 New York City

CALCULAGRAPH
THE ELAPSED TIME RECORDER

Telephone Activities in Foreign Countries

Dispatches from Abroad Keep Telephone Men in United States Constantly Informed Concerning Telephony of the World; Domestic Telephone Problems Oftentimes Can Be at Least Partially Solved by Watching the Outcome of Experiments Made Elsewhere

Extension of Automatic Telephone Service in Argentina

A new automatic telephone exchange was placed in the city of San Luis, Argentina, recently by the Cia. Argentina de Telefonos, an organization whose importance in the telephone operation field has grown constantly during the past few years. The new installations are of the most modern type of central automatic Ericsson system with a capacity of 500 numbers.

It is provided with an underground network of wires divided into various suburban districts to make possible immediate provision for an increase in the number of subscribers.

The general system of the Compania Argentina de Telefonos places the San Luis central in communication with the provinces of Mendoza, Cordoba, Santa Fe, Buenos Aires and Entre Rios, and the territory of La Pampa.

Telephone Installations in Sweden Show Increase

The Swedish Telephone and Telegraph service had 528,362 telephones in use at the end of the first quarter of 1931, compared with 522,450 at the end of 1930, and telephone connections established with 21 foreign countries. The State Telephone service program for 1931 includes the completion of a new automatic telephone central in Stockholm.

A new telephone cable of 64 kilometers in length will be laid in 1931 between Malmo and Copenhagen. It will be similar to the one recently opened between Sweden and Germany, which contains a special wire for the transmission of radio broadcasting. It is reported that a second cable will be laid in the near future between Sweden and Finland. The service further plans to establish direct connection between Sweden and Switzerland, and to enlarge the already existing service to England and the Netherlands.

Long Distance Calls Increasing in Germany

Berlin's present long distance telephone exchange, which is the largest in Europe, was opened four years ago. There are now about 65,000 long distance calls daily, of which 25,000 are going out, 30,000 coming in, and 10,000 in transit. Besides, there are about 30,000 calls daily on the "quick suburban service" which connects Berlin with the outlying suburbs.

Since the recent installation of the automatic slot telephone in public booths, there are about 1,000 to 1,200 additional long distance calls daily. It is intended to so improve long distance connections in Germany that one will soon be able to get a connection with Hamburg, Cologne, Frankfort, and so forth, just as one now does with Potsdam, which is about 30 kilometers from Berlin. It is projected to build 4,500 direct lines in Germany. There are already 130 lines to foreign countries.

Increased Rates in Fiji Islands Cause Difficulties

As the result of increased telephone rates in the Fiji Islands, made effective January 1, several small retail stores were reported to have given up their telephones, considering ten pounds per year too heavy a charge. (One pound equals $4.86.)

The Postmaster General, when interviewed, said he considered the rates moderate, and in view of the cost of the service, quite justified. He pointed out that the new rates compared favorably with those of other colonies and dominions of Great Britain, and that in Australia the rates are much higher.

Long-Distance Line Inaugurated in Australia

Telephone service between Brisbane, Queensland, and Perth, West Australia, has been established. In announcing the inauguration of its service the postal department stated that the line is among the longest land lines in the world, the distance being a little more than 3,400 miles.

Railway Call Offices Established in Great Britain

The growing popularity of the telephone as a time saver is demonstrated by the fact that the London & North Eastern Railway, in co-operation with the General Post Office, has recently installed 900 telephones at stations all over its system, including those on lines jointly operated with other companies. Over 500 of them have been provided at rural stations in rural areas and 142 stations serving East Anglian agricultural areas have now been equipped with telephone facilities.

Government Institutions Operate Telephones in Estonia

Three government institutions are permitted by law to establish and operate telephone systems in the country of Estonia. The owner of the most widespread telephone system in Estonia is the Estonian Post Administration, which controls practically all civil and public telephone communication throughout the country.

The two other government institutions operating there are the Estonian Railways and the Ministry of Defense. Private telephone systems may be established and operated within the boundaries of a certain piece of property, as, for instance, buildings, estates, factories, and farms.

Telephone Manufacturing Plant in Poland

In order that Poland may become independent of other countries for the supply of its automatic telephone instruments and apparatus, the government is reported to be planning to install a special plant, and for this purpose is stated to have granted a loan of approximately $2,673,000, of which $1,458,000 will be supplied in the form of goods. This loan is believed to have been granted to a British firm, but no confirmation has been obtainable. According to the plan, the government works for the manufacture of telegraph and telephone apparatus will begin supplying the needs of the Ministry of Posts and Telegraphs in 1933 at the rate of 3,000 automatic telephones a year.

Radio Telephone Connects Hokkaido and Sakhalin (Japan)

After four months tests which have proved successful, the Department of Communications has decided to install radio telephone connections between Hokkaido and Karafuto (Sakhalin). Stations are located at Sapporo and Toyhara. This service will be available to all telephone subscribers on both islands. It is the first installation of its kind in Japan.

"So Long TROUBLE!"

The man high up in the telephone company and the man high up on the telephone pole *both* are enthusiastic about Kester Solder!

The trouble-shooter finds Kester convenient to work with. No separate flux to bother with, for the flux is right there inside the solder.

As for the executive . . . he knows that Kester-Solder-protection for his lines will cut out high maintenance costs and add from 5 to 7 years to their life! Splices, sleeve-connections, grounds and drops all need the protection of solder. That's why many companies have rigged up travelling platforms, and are now soldering every joint in the system!

You need Kester! Write our Industrial Development Department about your soldering problems. Or get in touch with your jobber . . . he has Kester Solder on 1, 5 and 20 pound spools. Kester Solder Company, 4218 Wrightwood Ave., Chicago, Illinois. Incorporated 1899.

All Kester Solder exceeds Class A Purity Specifications of The A. S. T. M.

KESTER FLUX-CORE SOLDER

Acid-Core · Paste-Core · Rosin-Core

Another reason why Vacuum Grip Lineman Pliers are immensely popular with professional linemen—

the HANDLES are as practical as the "business end"

ONLY the lineman knows how important it is for his pliers to have *correctly designed handles.*

In designing the *head and body* of Vacuum Grip Lineman Pliers we gave the lineman "the best" that America's foremost pliers designers could produce. And then we added *practical handles*—to meet actual working conditions.

Gloves are not a handicap to the lineman who uses Vacuum Grip Lineman Pliers, as the handles *conform perfectly to the gloved hand.* In fact, they fit the glove even better than the glove fits the hand, enabling the lineman to perform any operation—gripping, pulling, twisting or cutting—with ease and speed.

Note also, from the photograph above, that with the jaws practically closed, sufficient space remains between the handle tips for the entrance of a *gloved finger,* to open the jaws.

The carefully "fashioned" handles of Vacuum Grip Lineman Pliers, full rounded on the edges, make it possible for the lineman to use them in the bare hand, without a trace of a bruise, even when tremendous pressure is applied.

Vacuum Grip Professional Lineman Pliers are made in four sizes: No. 8—(popular size) 8½"; No. 57—7"; No. 56—6"; No. 59—9". TO PURCHASING AGENTS we recommend running tests with a few No. 58's as the best demonstration of the superiority of these pliers, from the standpoint of longer life and greater economy as well as other advantages. Write today for special prices. Ask for Catalog describing other Vacuum Grip patterns valuable in your particular field.

FORGED STEEL PRODUCTS CO.
Newport, Pa.

Vacuum Grip REG. U.S. PAT. OFF. Pliers

Built UP to a Standard—Not DOWN to a Price

NEARLY A MILLION IN USE

Indiana Exchange Installs New Equipment

Eastern Indiana Telephone Company Serving Eight Thousand Subscribers Purchases Stromberg-Carlson Junior Multiple Switchboard for Hagerstown Exchange; Making a Total of Five Such Purchases for Exchanges of This Company, Which Is Striving for Standardization of All Equipment

By C. F. SANDERS, Sales Engineer
Stromberg-Carlson Telephone Manufacturing Company

Another step in its plan to standardize the telephone equipment in all its exchanges was made by the Eastern Indiana Telephone company of Winchester, Ind., when the installation of a Stromberg-Carlson Junior Multiple switchboard was recently completed at Hagerstown, Ind. Hagerstown is the fifth exchange in that company's system that has been equipped with Stromberg-Carlson apparatus.

In addition to Hagerstown the exchange at Winchester, Dunkirk, Parker and Cambridge City have this make of equipment.

Organized in 1895, the Eastern Indiana Telephone company has had a steady growth and today it furnishes telephone service to approximately 8,000 subscribers in Wayne, Portland and Randolph counties, situated in East Central Indiana.

It was in 1914 that the company started its standardization program in Winchester, the headquarters of the company. In that year it contracted with the Stromberg-Carlson company for new Central Energy office equipment for its home exchange.

In 1918 the company acquired control of Dunkirk and in 1919 contracted for new central office equipment for that exchange.

Again Stromberg-Carlson equipment was chosen.

In 1928 the company took over the Farmers' Telephone company, which served a strictly rural clientele about Winchester. In order to take care of the increased traffic resulting from the consolidation, it was evident that additional equipment would be necessary. After careful consideration of a system developed by the engineering department of the Stromberg-Carlson company, the management of the company decided to add Super-Service features to the board in operation at Winchester and to install a new Super-Service position.

The equipment handled the increase efficiently and economically and the results have confirmed the judgment of the management in its selection.

From time to time other properties were acquired by the company. In each case the plants were improved and in three of the exchanges new equipment was installed.

Among these exchanges acquired were Parker, Cambridge City, Hagerstown, Blountsville and Losantville.

The outside wire plant at Parker was improved and the central office was equipped with a new Stromberg-Carlson No. 105 Magneto switchboard.

The installation of a Stromberg-Carlson Junior Multiple at Cambridge City in 1928 was the last one preceding the one at Hagerstown.

During the latter part of 1929 the contract for the Junior Multiple switchboard for Hagerstown was given the Stromberg-Carlson company.

With each installation the Eastern Indiana Telephone company officials declare that the Stromberg-Carlson equipment has given them the nth degree of efficiency and economy.

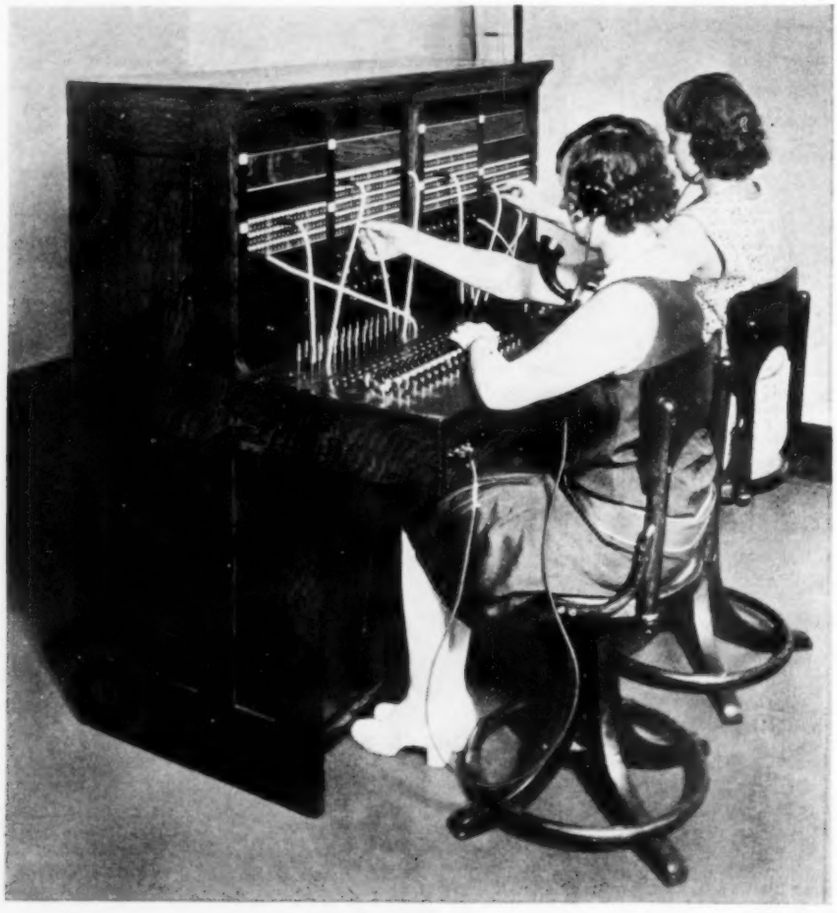
Hagerstown has a population of 1,500 and is located in Wayne county, Indiana's leading agriculture and dairying center.

It was founded by early settlers who came from Hagerstown, Md., after which it was named. In pioneer days Hagerstown was on a direct route to Cincinnati via the White Water canal. The canal was later replaced by the White Water railroad, which was built on the towpath along the canal.

The town is the home of the Perfect Circle company, manufacturers of about 85 per cent of all piston rings used in the United States.

Hagerstown is a progressive community and recently the Federal Government appropriated $80,000 for a new postoffice to be built this year.

(*Continued on page* 48.)



Two position Stromberg-Carlson junior multiple switchboard installed at Hagerstown, Indiana, by the Eastern Indiana Telephone Company

EFFICIENCY

Here are two lights universally accepted by "trouble shooters" as superior for every requirement.

The Industrialite makes and breaks contact conveniently through a twist of the top cap. An emergency bulb is kept in a tiny clip within the head assembly.

The Lantern needs no introduction to telephone men. It brilliantly illuminates a wide area and may be used at any angle.

BOND ELECTRIC CORPORATION
Jersey City, N. J.

CHICAGO SAN FRANCISCO

Do You Buy *Batteries* or *Hours of Service?*

COST per *service hour*—not cost per *battery*—is the only way to gauge battery prices. A telephone cell that gives only six or seven months of service is high-priced, no matter what you pay for it. Ray-O-Vac Telephone Batteries cost less because they deliver more hours of service than other batteries. Tests conducted in accordance with U. S. Government standards, as well as records of users, prove that Ray-O-Vacs deliver many hours more actual service than most other makes. And over a period of time, there's a considerable saving in service costs alone. It will pay you to standardize on Ray-O-Vacs. They *last* longer.

FRENCH BATTERY COMPANY
Madison, Wisconsin
General Sales Offices:
20 North Wacker Drive, Chicago, Illinois
Makers also of Flashlight Batteries, Rotomatic and Standard Flashlights and Electric Lanterns

RAY-O-VAC

A BETTER LINE *and it costs less...* MUCH LESS

The National Lumber and Creosoting Company brand is your assurance of poles that last longer, cost less per year, eliminate replacement expense. Southern Yellow Pine for Strength, Pressure Creosoted for Permanence. You can depend on these longer lived poles for enduring service—with economy.

National Lumber & Creosoting Company

GENERAL OFFICES: TEXARKANA, ARK.-TEX.

SALES OFFICES
Texarkana, Ark. Houston, Tex.
Kansas City, Misscuri
St. Louis, Mo. Denver, Colo. Superior, Wis.

TREATING PLANTS
Texarkana, Tex. Houston, Tex. Alexandria, La.
Finney (P. O. Col. Park, O) Kansas City, Mo.
Salida, Colo. Denver, Colo. Superior, Wis.

A DIVISION OF THE WOOD PRESERVING CORPORATION

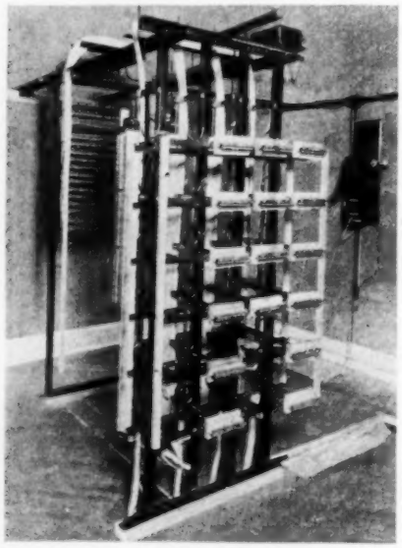
Frank Mack is manager of the telephone exchange at Hagerstown.

The telephone equipment installed to serve this thriving community consists of a two position Junior Multiple switchboard and complete terminal, power, machine and wire chief's testing equipment.

Both positions of the switchboard consist of high efficiency universal cord circuits and provide for the following features:

1. Bridged manual listening which permits the operator to listen in on either the answering or calling cord separately or when both cords are up on circuit.

2. Four party ringing or calling cord and also code ringing in either cord or harmonic ringing on answering cord in connection with four party master key.



Main distributing frame at Hagerstown, Indiana

3. Audible busy test which guards against connections with busy lines.

4. Repeating coils in each circuit to insure maximum talking efficiency with minimum noise from inductive disturbances.

5. First two cord circuits in each position are equipped with highly efficient repeating coil of ring through, talk through type, controlled by key to provide for ideal talking conditions for long distance service.

6. Balance of cord circuits in each position are equipped with repeating coils of non-ring through type eliminating confusion as subscribers' "ring-off" does not pass through the cord circuit to the connected line.

7. Double supervisory signals increase the efficiency of operating by designating to the operator which party on a connection has hung up or rung off.

8. Automatic adaptation to the line in which the plug is inserted precludes any necessity of particular cord selection. The connection may be made between any class of service such as central energy and central energy, magneto and magneto or magneto and central energy lines.

9. Generator cut off on calling cord which prevents subscribers from being rung in the ear after the receiver has been removed from the hook switch and the supervisory relay in cord circuit has operated.

The operator's telephone circuit provides the following features:

1. Anti-side tone qualities are provided wherein outgoing transmission, including the effect of local noises, is prevented from reaching the operator's receiver and interfering with good receiving.

2. Common monitoring key allows the operator to listen in on a connection with practically zero loss to the talking circuit.

3. Duplicate cut in jack. Duplicate jacks are provided so that the operator is enabled to listen in on a position while learning. The jack can also be used by the chief operator or monitor for cutting in on a position.

4. Circuit cut out is effected when the operator removes her head set from the jack. This act opens both the primary and secondary circuits so that when one position is switched to another there will be no losses by bridging circuits.

By the manipulation of a push button key, any two or more positions may be connected so that cord circuits of one position are available to the operator of an adjacent position. This arrangement is, at times, convenient for night service or when one operator alone is working at this switchboard.

JAPANESE TELEPHONE MAN SEEKS ASSISTANCE IN SOLVING TECHNICAL PROBLEMS

(*Continued from page* 40)

ground conduit system water tight. In this country no attempt is made to keep water out of a conduit system, but the conduit runs between manholes are given a minimum slope of 3 in. per one hundred feet. This permits any water which may enter the conduit to drain towards the manhole which eliminates the possibility of cable damage due to water accumulating around the cable and freezing. Conduit runs are drained either from the center toward each adjacent manhole or from one manhole to the next.

A brief summary of the methods of carrying telephone cable underground used in this country may be of interest and possible help to you. There are three basic methods which are used, viz.:

1. Cable carried in permanent underground duct.

2. Tape armored cable laid directly in the earth.

3. Lead sheath cable buried directly in the soil, or in some cases covered with a protective asphaltic compound.

Permanent underground conduit is used in all large cities and in some cases between cities for carrying toll cables.

One of the most popular of the underground conduit structures in use in this country is the multiple vitrified clay duct system using inch lengths fastened together with steel dowels and covered with concrete at each joint, or in some cases, the entire run is encased in concrete. Laterals consist of either 4 inch sewer tile or creosoted wood duct.

Another method widely used is to place round fibre duct in the trench and cover with concrete. This method is used more by power than telephone companies.

Tape armored cable for both toll and exchange use is extensively used at the present time, especially for toll service between cities.

Buried cable has never been approved by the larger telephone companies but has been adopted by many smaller companies with fair success.

Being unfamiliar with your local soil conditions and service requirements, I am not qualified to suggest which underground conduit construction system would be most suitable.

In this country the cost of a cast iron duct system such as you are using would greatly exceed the cost of conduit systems which are used. Cast iron conduit such as is available for water mains has the disadvantage of not being perfectly free from sharp projections on the inside and for this reason the sheath of a cable being pulled in might easily be damaged.

For your information I attach several bulletins covering underground construction methods used in this country.

I would be much interested in hearing from you relative to the physical characteristics of Karafuto, and especially about your telephone company activities. If I may be of assistance in any other telephone problems which you may have, please feel free to write me.

Yours truly,

B. C. Burden,
Transmission Engineer.

INSTALL TELEPHONES AS SAFETY MEASURE

School trustees in many school districts in Oklahoma, particularly in the northwestern counties of the state, are considering installation of telephones in district school houses as a safety measure, according to the Oklahoma Utilities Association.

This interest springs from announcement of passage of a law in Colorado requiring telephones in all country school houses as a result of the blizzard in southeastern Colorado in March, in which five school children were frozen to death. The movement is receiving general attention and support in Kansas and Nebraska also.

Cedar Poles

Northern White Western Red
Plain or Treated Butts

Prompt Shipment from Minneapolis Yard.

T. M. Partridge Lumber Co.
Minneapolis, Minn.

THE NEW STEWART DIRECT READING TEST CABINET

Operates on eight No. 6 dry cells, and costs but $2.00 per year to operate. Installed as easy as a telephone. We furnish a mile chart that gives distance to trouble on all kinds of wire. Price $56.00 for 15-volt scale. $61.00 for 150-volt scale. Sent on trial. Write for literature.

STEWART BROTHERS, Ottawa, Ill.

dependable

NORTHERN WHITE CEDAR POLES

that offer *utmost* in Quality and Value.

***Guaranteed* Butt Treatments**

MICHIGAN POLE & TIE CO.

NORTHERN AND WESTERN POLES
NEWBERRY, MICHIGAN

Reed City, Mich. YARDS St. Paul, Minn.

DEPENDABILITY . . . long life . . . economical operating and maintenance costs are the reasons why the use of Exides is increasing in P.B.X. service.

EXIDE-IRONCLAD P.B.X. BATTERIES

Exide - Ironclad Battery, type B.I.-5, especially designed and constructed for P.B.X. service.

Tubular construction of Exide Ironclad positive plate gives longer battery life.

Exide BATTERIES

THE ELECTRIC STORAGE BATTERY CO., PHILADELPHIA

SERVING CANADA . . .

With a Complete Stock of Telephones, Dial and Manual Switchboard Equipment, Construction Materials and Supplies

We are prepared to furnish telephone organizations throughout Canada with any item of telephone equipment—from the smallest article up to complete installations of metropolitan telephone systems. The products which we distribute are so well known that no detailed description of their high quality is necessary. In addition to this most complete line, we have our own manufacturing and repair facilities—each department is under the supervision of an expert. Consult us before making your next purchase—prices and proposals gladly furnished upon request.

Independent Sales and Engineering Company, Limited

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Representatives in Canada for

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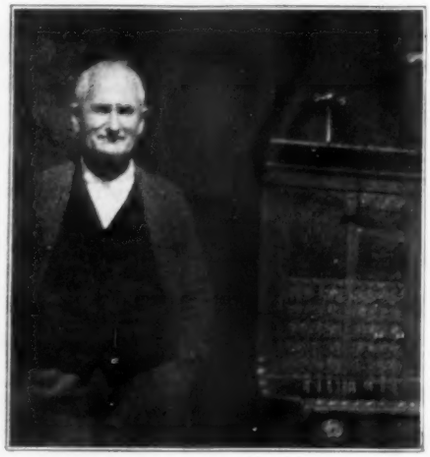
THE AUTOMATIC ELECTRIC COMPANY, LIMITED, Chicago
ALTON BATTERY COMPANY, Alton, Eng.

A REAL RECORD OF SERVICE!

It was way back in the dark days of 1907 that Ed Bishop of Marston, Mo., bought the Kellogg switchboard shown with him in the accompanying illustration. And he bought it *second hand* at that, so there is no telling how old the board really is.

At any rate, Bishop and his board have been serving the people of Marston and Point Pleasant of Missouri with faultless telephone service for a good many years. During all this time not one cent has been spent for repairs on the board with the excepetion of replacing several 100 ohm coils with 500 ohm coils. The board has a one hundred line capacity with about sixty drops and jacks installed.

Mr. Bishop tells of a recent incident demonstrating the remarkable efficiency of his Kellogg board despite its many years of use. He put a call through to a town some ten miles distant. At



Ed Bishop and his Kellogg switchboard with which he has been serving Marston, Mo., for many years

the receiving end, another operator ten or fifteen feet from the board heard and recognized his voice. He at the same time was able to hear her laugh clearly even though she was some distance from the transmitter. Mr. Bishop calls it his ancient board giving modern service—and as far as transmission is concerned, he certainly is right.

FOR SALE

Slightly used twisted drop-wire, 200 to 800 foot lengths. $30.00 per ton.

W. M. Miller & Sons,
2553 Madison St., Chicago, Ill.

ACCOUNTING

HERDRICH AND BOGGS
Certified Public Accountants
Specializing in Telephone Accounting and Rate Cases Since 1918.
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Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.
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Rm. 2130 Bankers Bldg., Chicago

RECONSTRUCTED EQUIPMENT

Western Elec. No. 317 inside connection compacts equipped with No. 22 3-bar Gen., No. 38 1000 ohm 3-inch gong ringer, No. 250 Trans., No. 13 Ind. Coil and No. 122 Rec. @ $6.60 ea. Lots 10 or more @	$6.30
Western Elec. No. 317 compact same as above, but with 1,000-1,600 or 2,500 ohm ringer and 4-bar Gen. of well-known Mfg. @ $8.25—Lots 10 @	8.00
Western Elec. No. 317 compact, same as above, but with 5-bar Gen. @ $9.50—lots of 10 @	9.25
Chicago Tel. Supply Co. 4-bar 1,600 ohm Bdg. compacts @	6.75
Am. Elec. No. 36 5-bar 1,000 or 1,600 ohm Bdg. compacts with Kellogg Trans. @	8.25
Kellogg No. 28 Cast head desk set with W. E. No. 240 3-bar 1,000 or 1,600 ohm external post signal set @	8.00
Kellogg desk set, same as above, but with Stromberg 4-bar 1,000 or 1,600 ohm inside cord connection signal set @	8.75
Cook No. 10 Arresters with heat coils and carbons, per bank 20 lines @	8.50
Leich Elec. Co., desk set with Stromberg 4-bar 1,000 or 1,600 ohm inside cord connection signal set @	8.75
Dean Elec. No. 240 4-bar 1,000 or 1,600 ohm Bdg. compacts with Kellogg Transmitter @	6.75
Kellogg No. 97 C. B. desk set with either 404 or No. 259 Steel bell box with Straight line ringer @ $7.00—Harmonic with 16-33-50 or 66 cycle ringer @	7.50

Write for Bulletins

REBUILT ELECTRIC EQUIPMENT CO.
1940 West 21st Str., Pilsen Station
Chicago, Ill.

PROTECT YOUR CABLE WITH EVERPROTECT

Permits underground installation without conduit. Protects cable against storm damage, corrosion, chemical action, electrolysis and abrasion.

Ask your nearest Jobber for complete details.

NATIONAL CABLE COMPOUND CO., INC.
Mitchell Indiana

FOR SALE

This month only. Brand new three conductor brown desk stand cords, $15.00 per hundred. Also brand new Bakelite mouthpieces for W. E. transmitters. $5.00 per hundred.

W. M. Miller & Sons,
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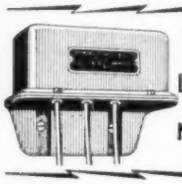

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